



Final

Record of Decision

Site UXO-06, Operable Unit 24

Marine Corps Base Camp Lejeune
North Carolina
February 2018

1 Declaration

1.1 Site Name and Location

This Record of Decision (ROD) presents the Selected Remedy for addressing explosive hazards from munitions and explosives of concern (MEC) and/or material potentially presenting an explosive hazard (MPPEH) at Operable Unit (OU) 24, Military Munitions Response Program (MMRP) Site UXO-06 (**Figure 1**), located at Marine Corps Base (MCB) Camp Lejeune in Onslow County, North Carolina.

MCB Camp Lejeune was placed on the United States Environmental Protection Agency (USEPA) National Priorities List (NPL) effective November 4, 1989 (USEPA Identification: NC6170022580). The remedy set forth in this ROD was selected in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This decision is based on information contained in the Administrative Record (AR) file for this site. Information not specifically summarized in this ROD or its references but contained in the AR has been considered and is relevant to the selection of the remedy at OU 24. Thus, the ROD is based on and relies upon the entire AR file in making the decision. Because of the NPL listing, and pursuant to CERCLA, the USEPA Region 4, North Carolina Department of Environmental Quality (NCDEQ), the Department of the Navy (Navy), and the United States Marine Corps (USMC) entered into a Federal Facilities Agreement (FFA) for MCB Camp Lejeune in 1991. The primary purpose of the FFA is to ensure that the environmental impacts associated with past and present activities at the Base are thoroughly investigated, and remediation of hazardous substances are undertaken in accordance with CERCLA when determined necessary to protect human health and the environment. The Installation Restoration Program (IRP) is responsible for ensuring that appropriate CERCLA response alternatives are developed and implemented as necessary to protect public health, welfare, and the environment. Additionally, because of previous use of the site as a training area resulting in potential presence of MEC/MPPEH, the site is managed under the MMRP. No enforcement activities have been recorded at Site UXO-06.

1.2 Statement of Basis and Purpose

The Navy is the lead agency and provides funding for site cleanups at MCB Camp Lejeune. The remedy set forth in this ROD has been selected by the Navy, USMC, and USEPA. NCDEQ, the support regulatory agency, actively participated throughout the investigation process, has reviewed this ROD and the materials on which it is based, and concurs with this Selected Remedy.

1.3 Scope and Role of Response Action

OU 24 is solely comprised of UXO-06 and is one of 25 OUs in the IRP at MCB Camp Lejeune. Information on the status of all the OUs and sites at MCB Camp Lejeune can be found in the current version of the Site Management Plan, available as part of the AR. This ROD presents the final remedial action for Site UXO-06 and OU 24.

1.4 Selected Remedy

1.4.1 Assessment of the Site

The Focused Site Inspections (SIs), Preliminary Assessment (PA)/SIs, and Remedial Investigation (RI) at Site UXO-06 have identified unacceptable risks to human receptors from explosive hazards. Potential explosive hazards were reduced significantly during the MMRP investigations; however, there are limitations to MMRP investigations, including those imposed by instrument limits and site conditions that prevent 100 percent removal. Therefore, MEC/MPPEH may remain onsite because MEC/MPPEH may not have been detected because of the above limitations, and some areas were not 100 percent investigated. Contact with the types of MEC/MPPEH that may be present could potentially result in injury or death. The response action selected in this ROD is necessary to protect public health or welfare from potential explosive hazards.

The Selected Remedy for the remediation target areas at Site UXO-06 is a Surface MEC Clearance and Land Use Controls (LUCs) to reduce or prevent the potential for direct physical contact with MEC/MPPEH to allow current and reasonably anticipated land use. The preferred alternative includes a MEC Surface Clearance, sign installation, unexploded ordnance (UXO) construction support, munitions safety awareness training, and administrative and legal controls that help to minimize the potential for exposure to contamination and protect the integrity of a response action.

1.4.2 Statutory Determinations

The Selected Remedy is protective of human health, complies with federal and state **applicable or relevant and appropriate requirements (ARARs)**¹, is cost-effective, and uses permanent solutions to the maximum extent practicable. The Selected Remedy satisfies the statutory preference for treatment as a principal element because a surface clearance includes onsite treatment (detonation) of surface MEC/MPPEH removed from within the accessible portions of the site. If MEC/MPPEH is later encountered in areas subject to LUCs, MCB Camp Lejeune explosive ordnance disposal (EOD) or UXO-qualified personnel will evaluate the material to determine if it poses an explosive hazard. Based on the evaluation, the Navy will take all necessary actions, including onsite treatment, as appropriate, to address unacceptable risks to human health and the environment.

Because the remedy will result in potential explosive hazards remaining onsite that prevent unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of the remedial action to ensure that the remedy is or will be protective of human health and the environment. The Navy will review the final remedial action no less than every 5 years after initiation of the remedial action, in accordance with CERCLA Section 121(c) and the NCP at 40 Code of Federal Regulations (CFR) § 300.4309 (f)(4)(ii). If results of the 5-year reviews reveal that remedy integrity is compromised and protection of human health is insufficient, additional remedial actions would be evaluated by the parties and implemented by the Navy.

1.5 Data Certification Checklist

The following information is included in **Section 2, Decision Summary** of this ROD. Additional information can be found in the AR file for MCB Camp Lejeune, Site UXO-06.

- Types of MEC/MPPEH identified during the MMRP intrusive investigations (**Section 2.5** and **Table 6**)
- Site Risks - Explosive Hazards (**Section 2.6**)
- How source materials constituting principal threats (MEC) are addressed (**Section 2.7**)
- Current and reasonably anticipated future land use assumptions used in the baseline risk assessment and ROD (**Section 2.6**)
- Potential land use that will be available at the site as a result of the Selected Remedy (**Section 2.10.3** and **Table 9**)

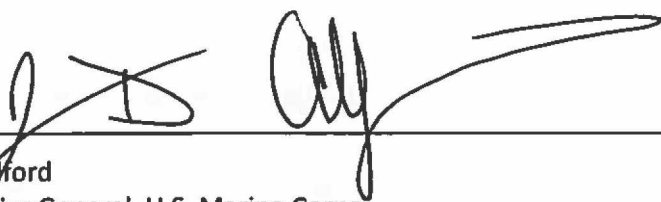
¹ **Bold blue text** identifies detailed site information available in the AR and listed in the References Table.

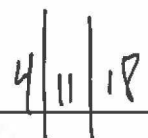
- Estimated capital, annual operations and maintenance, and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 2.9 and Table 10)
- Key factors that led to selecting the remedy (describing how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decision) (Section 2.9.2 and Table 11)

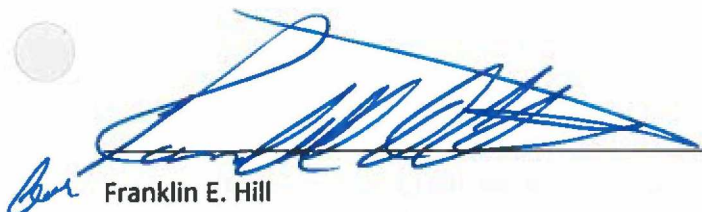
If contamination posing an unacceptable risk to human health or the environment is discovered after execution of this ROD, the Navy will undertake all necessary actions to ensure continued protection of human health and the environment.

1.6 Authorizing Signatures

This ROD presents the Selected Remedy at Site UXO-06, OU 24, at MCB Camp Lejeune, located in Onslow County, North Carolina.

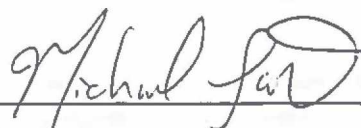

 J. D. Afford
 Brigadier General, U.S. Marine Corps
 Commanding General
 Marine Corps Base Camp Lejeune

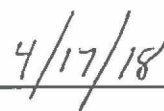

 Date


 Franklin E. Hill
 Director, Superfund Division
 United States Environmental Protection Agency, Region 4


 Date

With concurrence from:


 Michael Scott
 Director, Division of Waste Management
 North Carolina Department of Environmental Quality


 Date

2 Decision Summary

2.1 Site Description and History

MCB Camp Lejeune is a 156,000-acre facility located in Onslow County, North Carolina, adjacent to the southern side of the City of Jacksonville. The mission of MCB Camp Lejeune is to maintain combat-ready units for expeditionary deployment. The Base provides housing, training facilities, and logistical support for Fleet Marine Force and other assigned units.

Site UXO-06 (**Figure 1**) covers an area of approximately 450 acres in the Mainside area of MCB Camp Lejeune, south of McHugh Boulevard and west of Sneads Ferry Road; Gonzalez Boulevard crosses through the site. The southern boundary of the site mainly follows Cowhead Creek to Sneads Ferry Road.

Site UXO-06 consists of two areas:

- “Site UXO-06 Proper” refers to MMRP Site UXO-06 (Archive Search Report [ASR] Range #2.65, D-27).
- “MRS Adjacent to Site UXO-06” refers to the Munitions Response Site (MRS) area adjacent to Site UXO-06 Proper that was investigated based on the findings within Site UXO-06 Proper.

Throughout this document, “Site UXO-06” refers to both investigation areas, Site UXO-06 Proper and the MRS Adjacent to Site UXO-06.

Site UXO-06 Proper (ASR #2.65, D-27) was used from 1953 until 1977 as a training area for fortified beach assault. As a result of these historical activities, potential explosive hazards are present at Site UXO-06. The sources of potential explosive hazards are the MEC/MPPEH resulting from the historical use of the site as a **training area**.

Approximately 25 percent of Site UXO-06 is used as the Base borrow pit; 22 percent of the site consists of industrial buildings, barracks, dining facilities, and paved areas; 33 percent of the site is undeveloped and wooded; and the remaining 20 percent consists of mainly wetlands, restricted access areas, and creeks. Based on land use and the nature of munitions items found, Site UXO-06 has been divided into four main areas (Borrow Pit, Cantonment, Wooded, and Limited Use Areas), with the Borrow Pit further divided into two subareas (A and B) and the Cantonment Area further divided into three subareas (A, B, and C) (**Figure 1**). The portion of the borrow pit outside of the Borrow Pit Expansion Area but within Subarea A was not investigated because the majority of the borrow pit was in use and excavated for off-site fill prior to initiation of investigations at UXO-06. The location of the excavated material taken from this portion of the borrow pit was researched but could not be confirmed since records are not available.

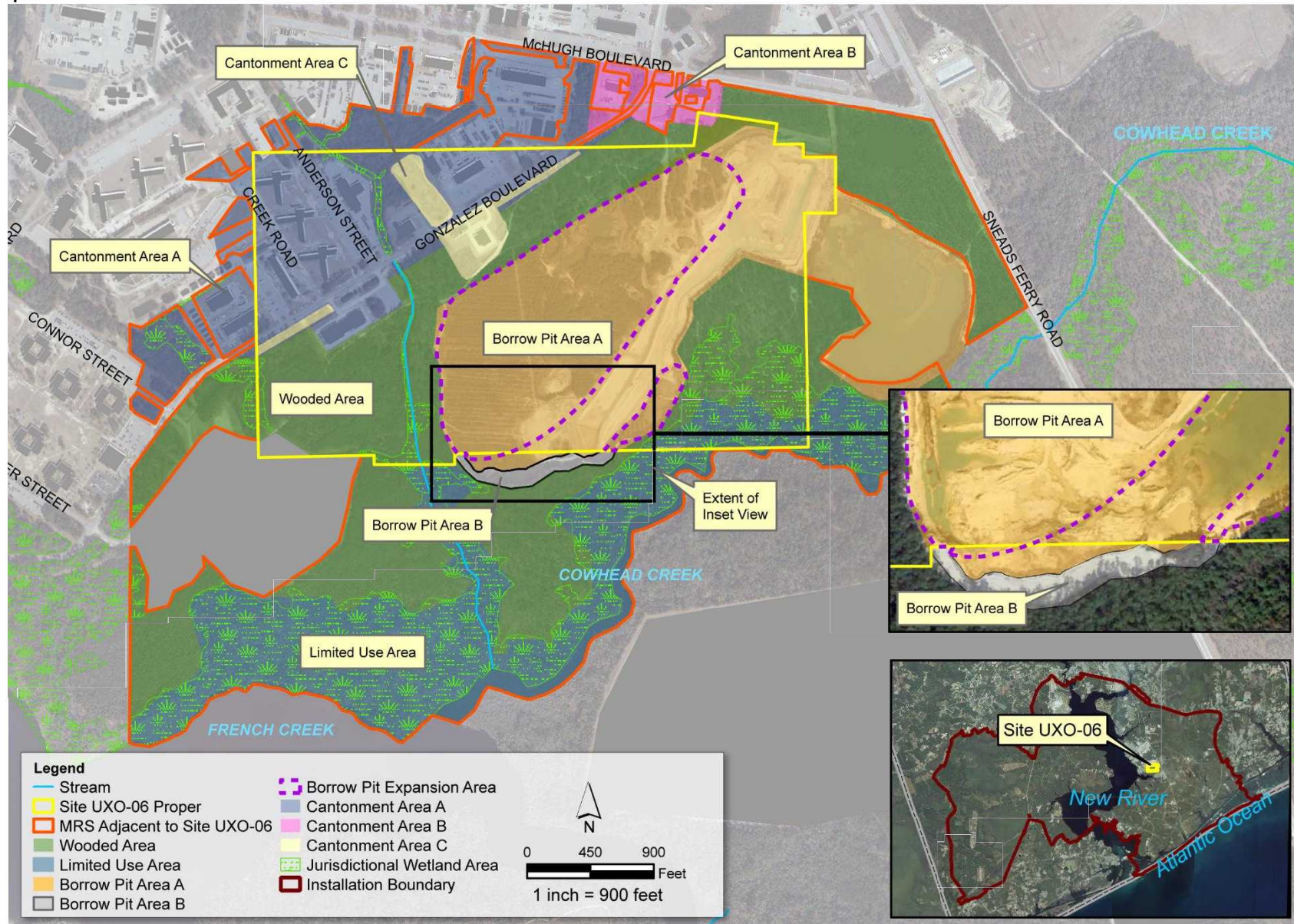
2.2 Site Characteristics

2.2.1 Topography, Drainage, and Surface Features

The topography of Site UXO-06 is relatively flat, varying from 0 to 25 feet above mean sea level, except for the 51-acre borrow pit where the topographic relief is approximately 40 feet due to borrow pit excavations (**Figure 1**). Water that accumulates in the borrow pit is pumped into the nearby pond in the eastern portion of the site.

Except for the borrow pit, the Site UXO-06 area is relatively flat near the developed areas surrounding Gonzales Boulevard, with local depressions near Cowhead Creek and an existing unnamed tributary. Surface runoff generally flows south and southwest toward Cowhead Creek, tributaries of French Creek, or directly into French Creek located on the southern boundary of the investigation area. Cowhead Creek and its tributary also discharge into French Creek, a tributary of the New River. Surface water runoff patterns are variable because of borrow pit excavations changing the topography of the site.

FIGURE 1
Site Map



2.2.2 Geology and Hydrogeology

Site-specific **geological and hydrogeological characteristics** were derived from soil borings collected during the PA/SI field activities. The geology underlying Site UXO-06 consists of layered laterally discontinuous fine-grained soil, consistent with the Tidewater region of the Atlantic Coastal Plain Physiographic Province. The soil is of marine and non-marine sources, ranging in age from early Cretaceous to Holocene. Soil consists of layered interfingered beds and lenses of sands, silts, clays, calcareous clays, shell beds, sandstone, and limestone that were deposited over pre-Cretaceous crystalline bedrock.

Site-specific hydrogeological information was derived from the installation of 14 shallow temporary monitoring wells. Water levels collected from the temporary monitoring wells in August 2008 (during the PA/SI) were used to predict groundwater flow at Site UXO-06. Surficial aquifer groundwater at Site UXO-06 appears to flow toward tributaries of French Creek and toward Cowhead Creek. Horizontal hydraulic gradients calculated from the potentiometric surface range from 0.0001 foot per foot to 0.0033 foot per foot.

2.3 Previous Investigations

Site UXO-06 was characterized through investigations conducted between 2006 and 2015, as summarized in **Table 1**. Reports generated from previous investigations at Site UXO-06 are part of the AR and can be referenced for further details.

TABLE 1
Summary of Previous Investigations/Studies

Previous Investigations/Studies	AR Numbers	Date	Activities and Findings
Focused SI (CH2M, 2007)	006698	2007	A Focused SI was conducted to evaluate the presence or absence of MEC and potential environmental impacts to site media. Field activities included soil and groundwater sampling and digital geophysical mapping (DGM) over 100 percent of the Military Construction (MILCON) area and a 1.2-acre buffer. Three MEC items and five MPPEH items (not including Small Arms Ammunition [SAA]) were found. Chlorinated solvents, metals, pesticides, and total petroleum hydrocarbons (TPH) were detected within the soil. Chlorinated solvents, metals, chloroform, and perchlorate were detected in groundwater. The Ecological Risk Screening (ERS) did not identify any significant ecological risks from exposure to soil or groundwater. The Human Health Risk Screening (HHRS) identified metals in soils as the only contaminants of potential concern. However, it was decided that the planned MILCON project for an armory and parking should proceed and the data would be incorporated with the sitewide Site UXO-06 data for further evaluation.
Focused PA/SI (Arcadis, 2007)	006700	2007	A focused PA/SI was conducted by Onslow County Water and Sewer Authority to evaluate the presence of MEC and/or impacted soil or groundwater within a proposed sewer line easement. Field activities included soil and groundwater sampling, and DGM over 100 percent of the easement that was located within UXO-06 Proper. No unacceptable risks to construction workers were posed by site media. All anomalies identified during the DGM activities were construction or cultural debris, with the exception of the following three MPPEH items: two practice 3.5-inch rockets and one expended smoke rifle grenade.
Phased PA/SI (CH2M, 2012)	004746	2007-2011	A phased PA/SI was conducted to evaluate the potential presence and nature of impacts to environmental media resulting from historical site activities and to gather geophysical data along transects (covering 10 percent of the site) as a preliminary step in assessing the nature and extent of potential subsurface MEC. Field activities included soil, groundwater, surface water, and sediment sampling; and 10 percent DGM, followed by an intrusive anomaly investigation. No MEC was encountered; however, 586 MPPEH items (not including SAA and

TABLE 1

Summary of Previous Investigations/Studies

Previous Investigations/Studies	AR Numbers	Date	Activities and Findings
			items in burial pits) were recovered. Five burial pits also were encountered and contained an additional 444 MPPEH items. The PA/SI recommended to further evaluate the potential for subsurface MEC in uninvestigated and undeveloped areas within the site and along the site boundaries. Chlorinated solvents, metals, and pesticides were detected in soil, groundwater, and surface water. Metals were detected in sediment. It was concluded that based on the current and anticipated future land use scenarios, exposure to soil, groundwater, surface water, or sediment was not expected to result in any unacceptable risk to human health or ecological receptors.
Focused SI - Borrow Pit Expansion Area (BPEA) (CH2M, 2009-2011)	002825, 004738, 005405, 005413, 005467, 004411, and 005466	2009-2011	A Focused SI was conducted at the UXO-06 BPEA in a phased approach. Field activities included 100 percent DGM, 100 percent intrusive investigation, and soil sampling. A total of 15 MEC items and 2,114 MPPEH items (not including SAA) were found. No further MEC investigations were recommended and the BPEA was released for use. Metals and explosives residues were detected within soil; however, the HHRS and ERS indicated that there were no unacceptable risks associated with exposure to soil.
Utility Construction Support (CH2M, 2012)	007116	2012	Construction support was provided for an underground utility corridor (approximately 10 feet wide by 2,700 feet long) MILCON project planned along the southern side of Gonzalez Boulevard to remove MEC and MPPEH from the portion of the utility corridor within Site UXO-06 Proper. Field activities included DGM over 100 percent of the utility corridor, followed by an intrusive investigation within bore pits that were used for horizontal drilling access. No MEC or MPPEH was recovered in this investigation; therefore, no further MEC investigations were recommended in the utility corridor and the utility corridor was released for use.
RI (CH2M, 2012-2013)	006483	2012-2013	An RI was conducted to further characterize the nature and extent of MEC and MPPEH contamination in uninvestigated and undeveloped areas via transects (that covered 10 percent in the accessible areas and 3.3 percent in the inaccessible areas) within Site UXO-06 Proper and in the MRS Adjacent to Site UXO-06. Field activities included DGM, an intrusive investigation, and post-detonation soil sampling. No MEC was encountered and 54 MPPEH items were found, not including SAA, which also was found. The RI evaluated all historical environmental media data from the investigations conducted to date and concluded that there are no significant impacts to environmental media from munitions constituents (MC) resulting from the presence of MEC/MPPEH and there are no unacceptable risks to human health or the environment identified from exposure to environmental media. Site UXO-06 was divided into four areas based on land use and the nature of munitions items found. An explosive hazard assessment also was conducted. No further action was recommended for the Borrow Pit Area and Cantonment Area C because the 100 percent investigation and removal of MEC/MPPEH resulted in a substantial reduction in potential hazards from contact with MEC. No further action was recommended for Cantonment Area A (Figure 1) based on finding only SAA and one ammunition can, which present a minimal threat if contact were to occur. A Feasibility Study (FS) was recommended for Cantonment Area B, Wooded Area, and the Limited Use Area in order to develop remedial action objectives and to develop and evaluate remedial alternatives to address potential threats from any MEC or MPPEH that potentially remains.

TABLE 1

Summary of Previous Investigations/Studies

Previous Investigations/Studies	AR Numbers	Date	Activities and Findings
MILCON Investigation (CH2M, 2015)	007130	2015	An investigation was conducted along a utility easement for a proposed force main within the Cantonment and Wooded Areas to evaluate the potential presence of subsurface MEC. Field activities included DGM (across 100 percent of the utility corridor and a 40-foot-wide buffer surrounding the corridor) and intrusive investigations over 100 percent of the utility easement. No MEC or MPPEH items were found; therefore, it was concluded that construction support is not needed in areas cleared for utilities.
FS (CH2M, 2016)	007113	2016	<p>The FS summarized the nature and extent of munitions-related contamination and potential explosive hazards, and developed and evaluated remedial alternatives for Cantonment Area B and the Wooded and Limited Use Areas to address the remaining potential explosive hazards at Site UXO-06. Portions of the Wooded Area were removed from further consideration because investigations revealed only two signal flares and SAA, which present a negligible hazard. Additionally, based on further regulatory review between the RI and FS, the following remediation target areas (see Section 2.6.4 and Figure 2) were carried forward in the FS:</p> <ul style="list-style-type: none"> • The portion of Cantonment Area C south of Gonzalez Boulevard where MEC items were found consistent with former training activities that were conducted south of the Cantonment Area • Borrow Pit Areas A and B because some portions were not investigated and have been identified for use for borrow pit operations <p>The FS evaluated the following remedial alternatives¹:</p> <ul style="list-style-type: none"> • 1 – No Action • 2 – LUCs <ul style="list-style-type: none"> – Option A – LUCs with fencing in high traffic areas and sign installation at targeted access points – Option B – LUCs with sign installation around perimeter • 3 – Surface MEC Clearance and LUCs • 4 – Surface MEC Clearance, Subsurface MEC Clearance through Removal of Discrete Anomalies, and LUCs • 5 – Surface MEC Clearance, Subsurface MEC Clearance through Excavation and Soil Screening, and LUCs
Proposed Plan (CH2M, 2017)	007180	2017	The Proposed Plan identified the Preferred Alternative (Alternative 3, Surface MEC Clearance and LUCs [Option B for signs]) to address the potential explosive hazards posed by MEC/MPPEH remaining in the remediation target areas at Site UXO-06.

¹ - Alternatives 3 through 5 assumed Alternative 2 Option B for access controls.

2.4 Environmental Media - Nature and Extent and Fate and Transport

Environmental investigations were conducted at Site UXO-06 from 2006 to 2015 (**Table 1**) to evaluate the potential impacts to environmental media from historical site activities. During these investigations, 95 surface soil, 80 subsurface soil, 24 groundwater, 7 surface water, and 7 sediment samples were collected from locations across Site UXO-06, as shown on **Figure 3**. Samples were analyzed for MC, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls, total organic carbon, total organic halogens, TPH, TPH-gasoline-range organics, and/or TPH-diesel range organics. Results were compared to screening criteria listed below as part of initial investigation activities to identify potential environmental releases. After human health and ecological risk evaluations indicated no unacceptable risk (**Section 2.6**), later investigations focused on MC related to MEC/MPPEH potentially remaining at the site.

FIGURE 2
Remediation Target Areas

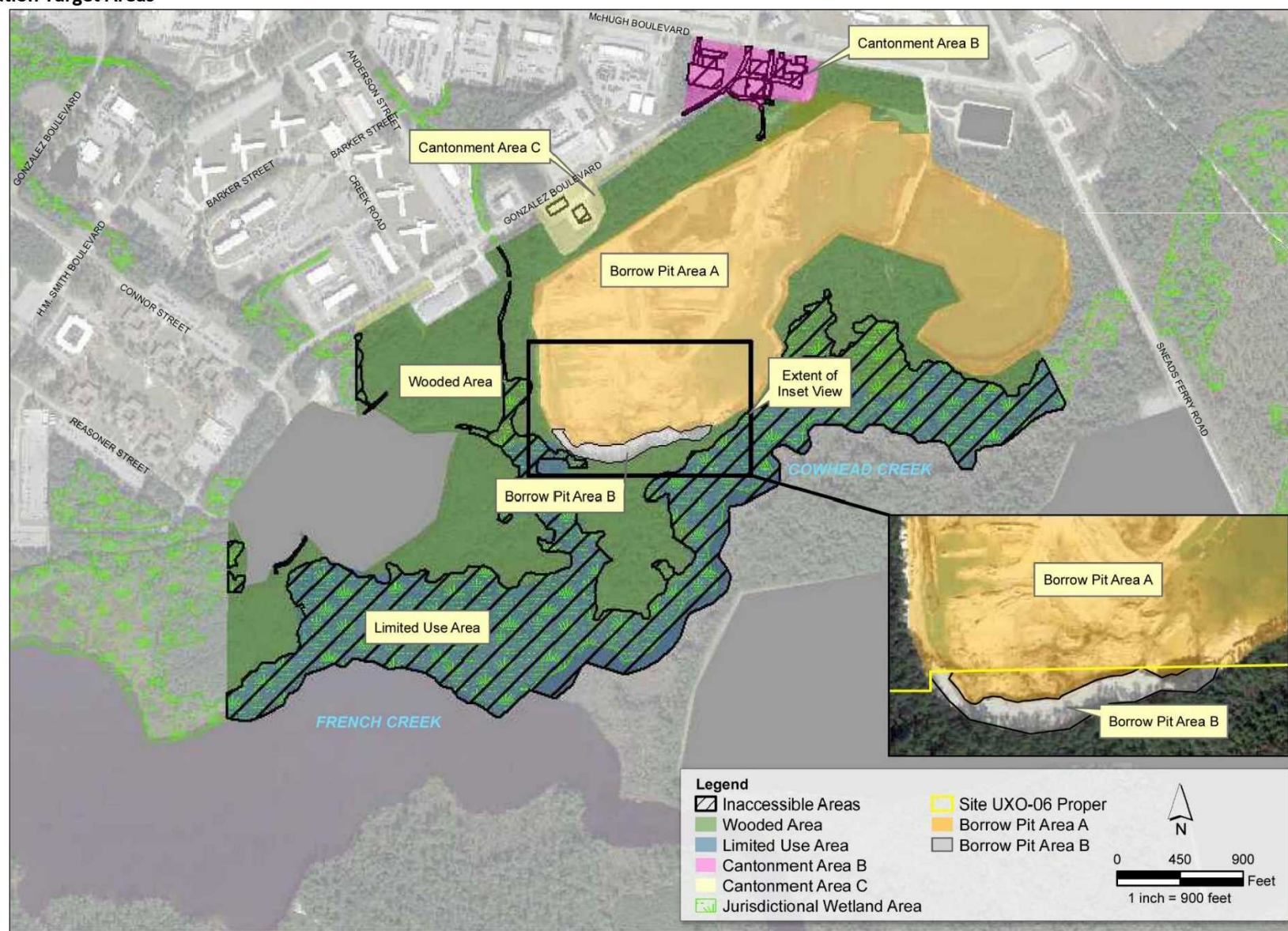
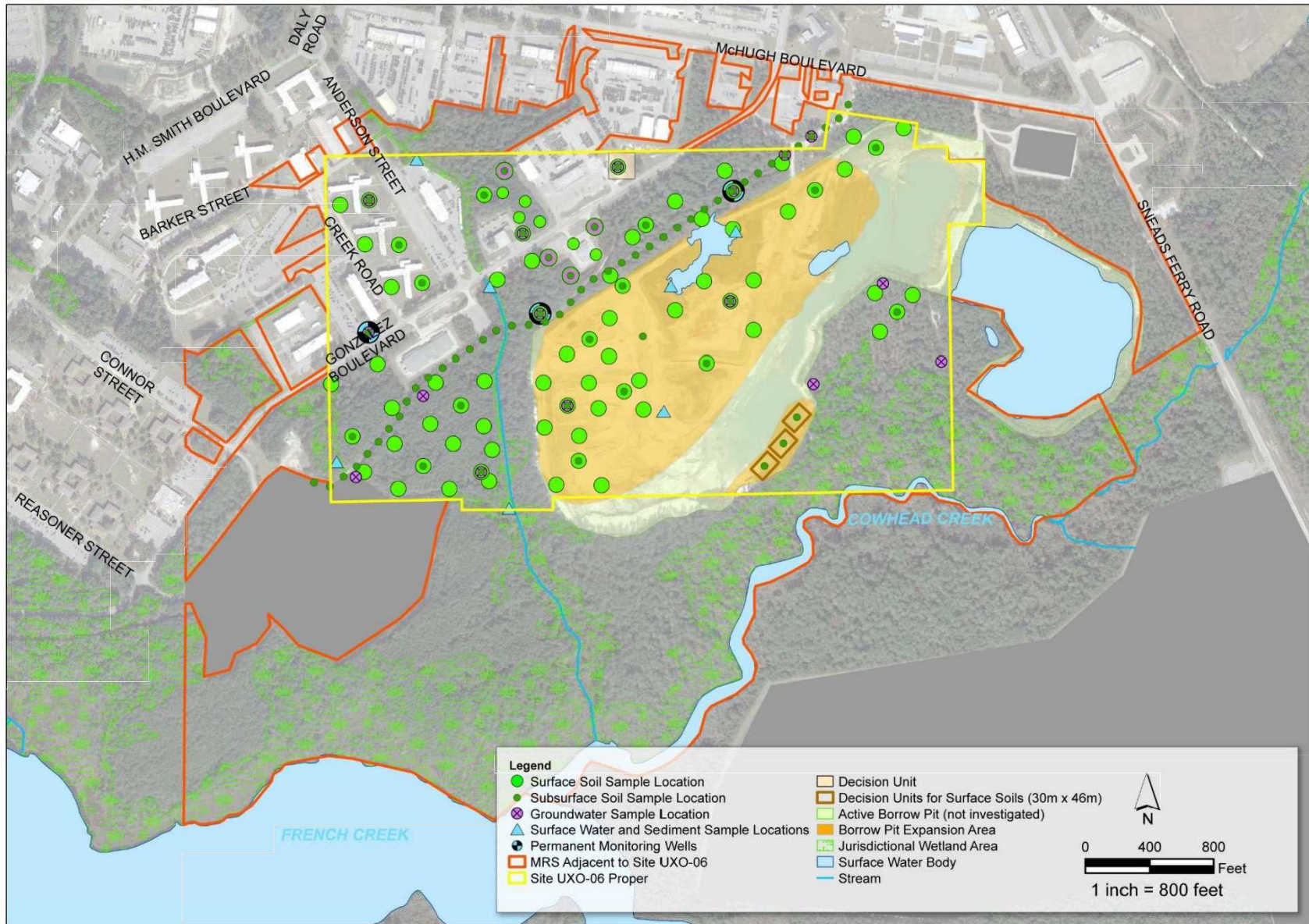


FIGURE 3
Environmental Sampling Locations



- Soil samples were compared to the North Carolina Soil **Screening Levels** for the protection of groundwater (NC SSLs), USEPA residential and industrial regional screening levels (RSLs²), and background for polyaromatic hydrocarbons and metals (**Table 2**).
- Groundwater samples were compared to the North Carolina Groundwater Quality Standards (NCGWQSs), USEPA tapwater RSLs², and background (Background Threshold Value [BTW] for MCB Camp Lejeune undeveloped area, combined soil types) (**Table 3**).
- Surface water samples were compared to the North Carolina Administrative Code 2B Surface Water Standards for human health and water supply and USEPA tapwater RSLs² (**Table 4**).
- Sediment samples were compared to the NC SSLs and USEPA residential and industrial RSLs² (**Table 5**).

Based on the results from the investigation of soil, groundwater, surface water, and sediment, there were no apparent MC impacts resulting from the presence of MEC/MPPEH. Perchlorate was the only explosives residue detected in one groundwater sample at an isolated location at concentrations above screening criteria. Metals were detected in soil, groundwater, surface water, and sediment at concentrations exceeding screening criteria and background at either isolated locations or in no definitive pattern across the site.

At isolated locations, two VOCs (chloroform and methylene chloride, both common laboratory contaminants), three SVOCs (2,4-dinitrotoluene, pentachlorophenol, and the common laboratory contaminant bis(2-ethylhexyl)phthalate), and two pesticides (dieldrin and 4,4'-dichlorodiphenyltrichloroethane [DDT]) were detected above screening criteria in soil, groundwater, and/or surface water.

TABLE 2
Soil Exceedance Summary

Constituent	Screening Level				Rate of Exceedances	Range of Concentrations
	Background ^a	NC SSL (October 2016)	Industrial Soil RSLs, HQ = 0.1 (June 2017)	Residential Soil RSLs, HQ = 0.1 (June 2017)		
Surface Soil						
SVOCs (µg/kg)						
2,4-Dinitrotoluene	NS	1.6	7,400	1,700	1/95	56 J
Pentachlorophenol	NS	4.8	4,000	1,000	1/35	55 J
Metals (mg/kg)						
Aluminum	12,800	NS	110,000	7,700	1/95	264 - 17,500
Arsenic	1.17	5.8	3	0.68	6/95	0.18 J - 2.3
Iron	7,210	150	82,000	5,500	1/95	153 - 7,370
Manganese	37	65	2,600	180	1/95	2.5 - 133
Thallium	NS	0.28	1.2	0.078	1/95	0.42 J
Vanadium	17.6	6	580	39	1/95	1.1 J - 23.2

² Based on a Hazard Index (HI) of 0.1 and Cancer Risk of 10⁻⁶

TABLE 2
Soil Exceedance Summary

Constituent	Screening Level				Rate of Exceedances	Range of Concentrations
	Background ^a	NC SSL (October 2016)	Industrial Soil RSLs, HQ = 0.1 (June 2017)	Residential Soil RSLs, HQ = 0.1 (June 2017)		
Subsurface Soil						
VOCs (µg/kg)						
Methylene Chloride	NS	23	320,000	35,000	2/35	69 - 74
Metals (mg/kg)						
Aluminum	19,000	NS	100,000	7,700	2/80	900 - 23,000
Arsenic	5.09	5.8	3	0.68	2/80	0.24 J - 8.2 J

^a Background Threshold Value (BTV) for MCB Camp Lejeune undeveloped area, combined soil types

µg/kg = micrograms per kilogram; mg/kg = milligrams per kilogram; HQ = Hazard Quotient; NS = no screening level; J indicates analyte is present; value may or may not be accurate or precise.

TABLE 3
Groundwater Exceedance Summary

Constituent	Screening Level			Rate of Exceedances	Range of Concentrations
	Background ^a (April 2012)	NCGWQS (January 2016)	Tapwater RSL (June 2017)		
VOCs (µg/L)					
Chloroform	NS	70	0.22	5/19	13 - 65
Methylene Chloride	NS	5	11	3/19	6.2 J - 17 J
SVOCs (µg/L)					
bis(2-Ethylhexyl)phthalate	NS	3	5.6	5/19	1.5 J - 13
Explosives Residues (µg/L)					
Perchlorate	NS	NS	1.4	1/19	0.07 J - 8.7
Total Metals (µg/L)					
Aluminum	14,000	NS	2,000	5/24	212 J - 290,000
Antimony	3.91	1 ^b	0.78	7/24	2.4 J - 7.6 J
Arsenic	9.79	10	0.052	7/24	1.6 J - 26
Barium	359	700	380	1/24	38.8 J - 480
Beryllium	0.874	4 ^b	2.5	1/24	0.089 J - 14.1
Cadmium	NS	2	0.92	1/24	0.72 J - 3.9
Chromium	16.9	10	0.035	7/24	1.3 J - 461
Cobalt	3.38	1 ^b	0.6	5/24	1.1 J - 5.4 J
Copper	6.59	1,000	80	3/24	2.6 J - 93.2
Iron	16,100	300	1,400	23/24	229 - 120,000
Lead	8.92	15	15	2/24	1.8 J - 110

TABLE 3
Groundwater Exceedance Summary

Constituent	Screening Level			Rate of Exceedances	Range of Concentrations
	Background ^a (April 2012)	NCGWQS (January 2016)	Tapwater RSL (June 2017)		
Manganese	176	50	43	15/24	8.7 J - 964 J
Nickel	11.8	100	39	6/24	1.5 J - 220
Silver	0.724	20	9.4	1/24	1.2 J
Thallium	NS	0.2 ^b	0.02	1/24	5.1 J
Vanadium	26.7	0.3 ^b	8.6	8/24	0.31 J - 390
Zinc	41.2	1,000	600	3/24	5.4 J - 1,400

^a BTV for MCB Camp Lejeune Surficial Aquifer

^b IMAC = Interim Maximum Allowable Concentration

µg/L = micrograms per liter; J indicates analyte is present; value may or may not be accurate or precise.

TABLE 4
Surface Water Exceedance Summary

Constituent	Screening Level		Rate of Exceedances	Range of Concentrations
	NC2B	Tapwater RSLs (June 2017)		
Pesticides (µg/L)				
4,4'-DDT	0.0002	0.23	1/7	0.01 J
Dieldrin	0.00005	0.0018	1/7	0.01 J
Metals (µg/L)				
Aluminum	NS	2,000	2/7	424 - 27,700
Chromium	NS	0.035	5/7	1.2 J - 28.2
Iron	NS	1,400	2/7	363 - 9,930
Manganese	NS	43	2/7	9.4 J - 46.6
Thallium	NS	0.02	1/7	5.1 J
Vanadium	NS	8.6	1/7	2.8 J - 39.4 J

µg/L = micrograms per liter

J indicates analyte is present; value may or may not be accurate or precise.

TABLE 5
Sediment Exceedance Summary

Constituent	Screening Level			Rate of Exceedances	Range of Concentrations
	NC SSL (February 2012)	Industrial Soil RSLs, HQ= 0.1 (June 2017)	Residential Soil RSLs, HQ=0.1 (June 2017)		
Metals (mg/kg)					
Aluminum	NS	110,000	7,700	4/7	1,470 - 15,500
Arsenic	5.8	3	0.68	5/7	0.28 J - 2
Chromium	3.8	6.3	0.3	7/7	2.5 - 14.6
Cobalt	0.9	35	2.3	1/7	0.075 J - 2.4 J
Iron	150	82,000	5,500	7/7	698 - 5,240
Manganese	65	2,600	180	1/7	6.3 - 72
Vanadium	6	580	39	5/7	3.6 J - 19.9

mg/kg = milligrams per kilogram

HQ = Hazard Quotient

J indicates analyte is present; value may or may not be accurate or precise.

2.5 MEC/MPPEH - Nature and Extent and Release Mechanisms and Migration

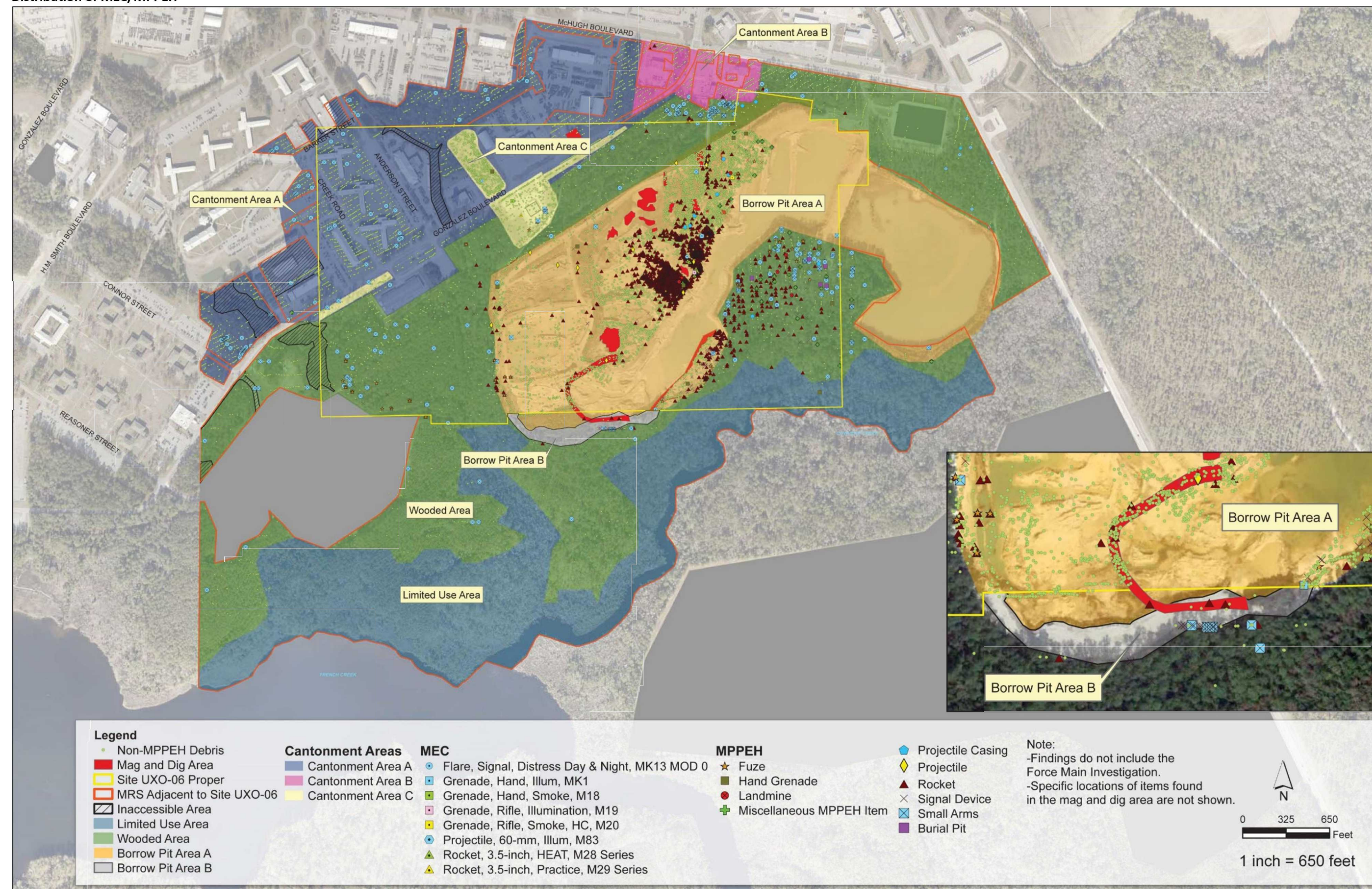
Intrusive investigations were conducted across approximately 17 percent of the 450-acre site. A total of 17,099 anomalies were investigated; 18 MEC items and 2,729 MPPEH items, not including SAA, have been found at Site UXO-06 (**Figures 4 and 5**, and **Table 6**); and SAA was found at 249 anomaly locations. Most of the MEC and MPPEH was found in the central portion of the Borrow Pit Area, which correlates with the results of the historical imagery analysis, which concluded that the center of the training operations was most likely in this area.

All 18 recovered MEC items were located in the subsurface (between 2 inches and 3.5 feet below ground surface [bgs]) within Site UXO-06 Proper (**Figure 1**). The majority (15) of the MEC items were found within the Borrow Pit Area at depths ranging from 2 inches to 3.5 feet bgs and consisted of rockets, projectiles, pyrotechnics, and screening/marketing devices. Three MEC items were found in support of a MILCON project in Cantonment Area C near Gonzalez Boulevard at depths between 2 inches and 2 feet bgs.

Most of the MPPEH items were located in the center of the Borrow Pit Area at depths of 0 to 4 feet bgs. The MPPEH items found within the surrounding Wooded Area were similar in type but fewer in number and were found up to 5 feet bgs; however, within the Wooded Area, five burial pits and one cache were found and investigated (**Figure 4**). The burial pits extended up to 6 feet bgs and contained 2.36-inch and 3.5-inch rocket fragments, 5.56-millimeter (mm) blank ammunition, M22 flares, and ammunition links and canisters; the cache extended to a depth of approximately 2 feet bgs and contained 0.30-caliber blank ammunition. Within the Cantonment Area, subsurface MPPEH items were found at depths ranging from 1 to 14 inches bgs, mainly in the northeastern portion (Cantonment Area B). Elsewhere in the Cantonment Area, excluding the MILCON project areas, only SAA casings and one ammunition can were found (**Figure 4**). All MPPEH found at Site UXO-06 was classified as material documented as safe and was shipped for witnessed disposal by thermal treatment. The MEC/MPPEH found at Site UXO-06 are detailed in **Section 2.6.3**.

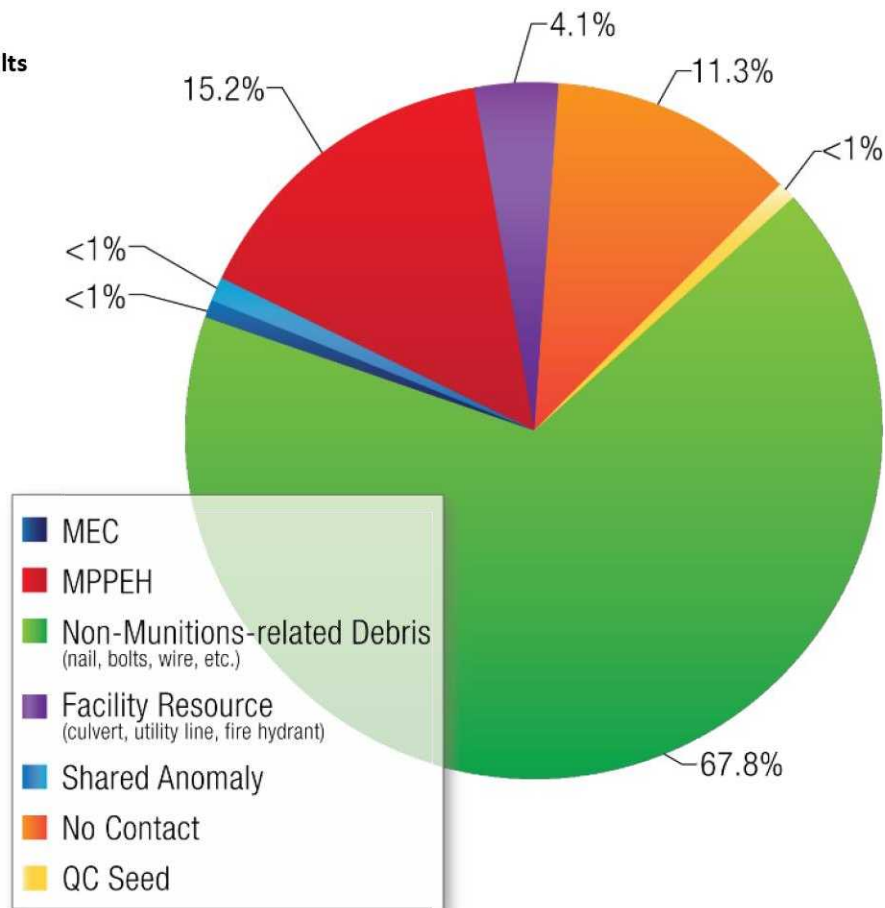
The only mechanism for the migration of MEC/MPPEH is through human transport. MEC/MPPEH is unlikely to be deeper than 4 feet bgs due to penetration; however, site activities (construction, filling of low areas, resulting erosion, etc.) may disturb MEC/MPPEH potentially below the surface and/or cause MEC/MPPEH to become buried to deeper depths. The conceptual site model (CSM) (**Figure 6**) presents a summary of the MEC-related hazard sources, exposure pathways, and receptors.

FIGURE 4
Distribution of MEC/MPPEH



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FIGURE 5
Intrusive Investigation Results



Notes:

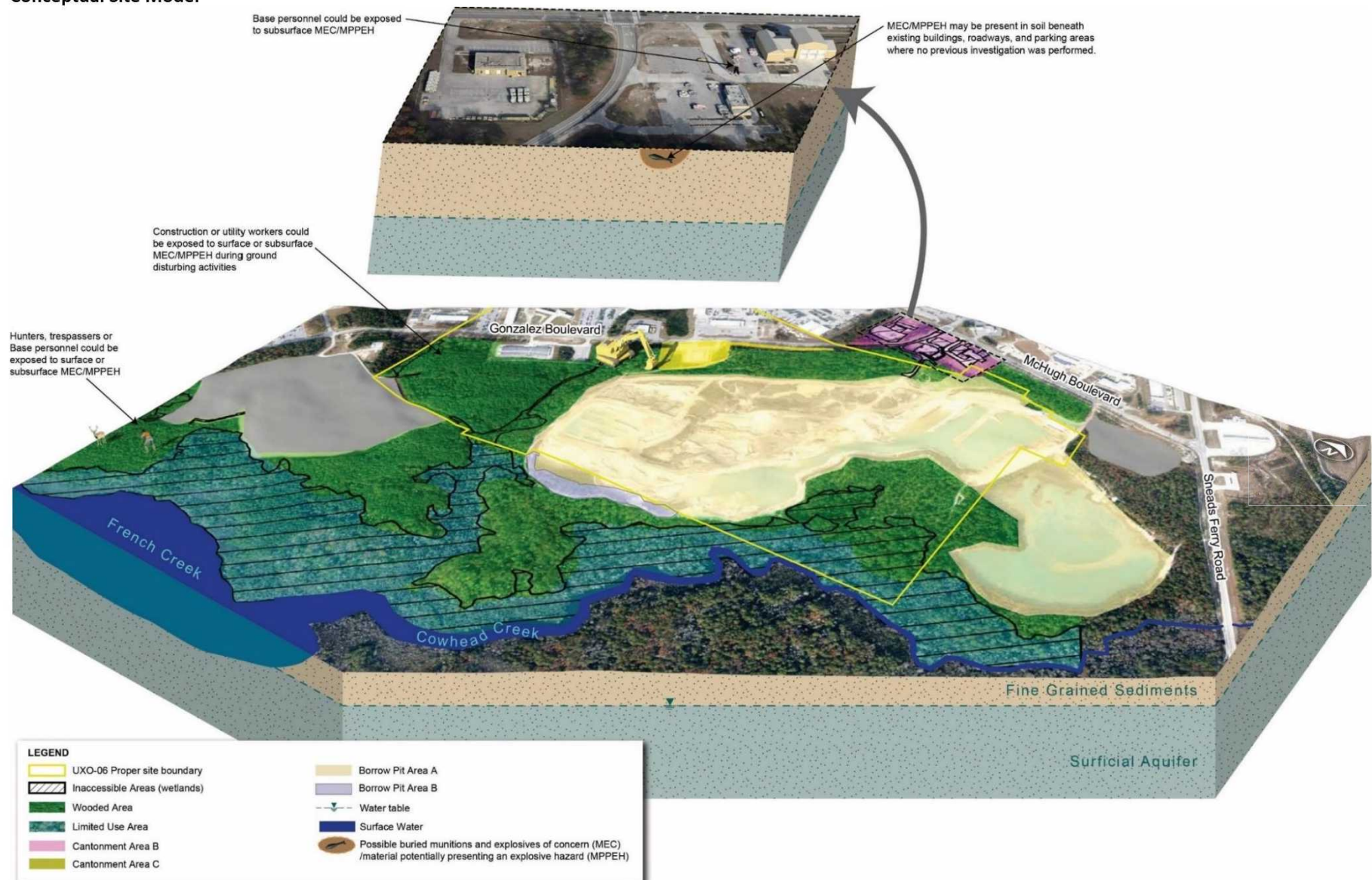
- 1 Percentages are based on the number of anomaly locations.
- 2 MPPEH includes SAA.

TABLE 6
Type and Quantities of MEC/MPPEH

Item Type	Number of Items ^a	
	MEC	MPPEH
Ammo Can	Not applicable	37
Flares	1	81
Fuzes	0	79
Firing Device	Not applicable	2
Frag	Not applicable	9
Grenades	5	107
Mines	0	9
Mortar Projectiles	0	11
Projectiles	1	31
Rockets	11	2,363
Small Arms Ammunition	Not applicable	249
Total	18	2,978

^a Multiple items were found at some individual anomaly locations.

FIGURE 6
Conceptual Site Model



2.6 Summary of Site Risks

Potential human health and ecological risks from exposure to site media and explosive hazards from MEC/MPPEH at Site UXO-06 were evaluated as part of the PA/SI and RI/FS. The following subsections briefly summarize the findings of these risk assessments.

2.6.1 Site Risks – Human Health

The Human Health Risk Assessment (HHRA) evaluated the potential risks to human health from exposure to constituents in surface soil, combined surface and subsurface soil, groundwater, surface water, and sediment. The HHRA included in the RI was an update to the HHRA included in the PA/SI. The HHRA was performed in two phases. The first phase was a conservative preliminary HHRS performed using human health risk-based screening values and MCB Camp Lejeune BTVs (for metals in soil and groundwater). The HHRS included comparison to these screening values and a risk ratio evaluation for analytes with concentrations exceeding the screening levels. The second phase of the risk evaluation, a baseline HHRA, was performed for those media that the HHRS indicated the potential for unacceptable human health risks (for media where chemicals of potential concern [COPCs] were identified). Only those media that showed the potential for unacceptable human health risks based on the first phase (HHRS) were evaluated in the second phase of evaluation (the baseline HHRA). For the groundwater risk assessment, only the individual wells with COPCs identified in the HHRS were evaluated to the HHRA.

Phase 1 – HHRS

The HHRS, was conducted in three steps using a [risk ratio technique](#) as follows:

- **Step 1** – Maximum detected constituent concentrations for each medium were compared to the USEPA RSLs (tapwater RSL for groundwater and residential soil RSL for soil and sediment, based on a target hazard index [HI] of 0.1 for non-carcinogenic endpoints and a carcinogenic risk of 1×10^{-6} for carcinogenic endpoints), other HHRS levels (15A North Carolina Administrative Code [NCAC] 2B WQS for Water Supply, 15A NCAC 2B WQS for Human Health, or Federal Ambient Water Quality Criteria, Consumption of Water and Organisms for surface water), and background concentrations for metals (available for groundwater and soil).
- **Step 2** – If a chemical was identified as COPC in Step 1, a corresponding risk level was calculated by multiplying the maximum concentration by the acceptable risk level and dividing by the RSL (based on a target HI of 1 for non-carcinogenic endpoints and a carcinogenic risk of 1×10^{-6} for carcinogenic endpoints). USEPA identifies an acceptable cancer risk range of 1 in 10,000 (10^{-4}) to 1 in 1,000,000 (10^{-6}) and below, and an acceptable non-cancer hazard as an HI that does not exceed 1. An acceptable carcinogenic risk level of 1×10^{-6} and an acceptable non-carcinogenic HI of 1 were used to calculate the corresponding risk level for carcinogenic and non-carcinogenic analytes, respectively. All corresponding risk levels were summed to calculate the cumulative corresponding HI for non-carcinogens and cumulative corresponding cancer risk (CR) for carcinogens. A cumulative corresponding HI for each target organ/effect also was calculated. If the cumulative corresponding HI for a target organ/effect was greater than 0.5 or the cumulative CR was greater than 5×10^{-5} , the chemicals contributing to these values were identified as COPCs and carried forward to Step 3.
- **Step 3** – A corresponding risk level was calculated as discussed in Step 2; however, the 95 percent upper confidence limit was used in place of the maximum detected concentration. COPCs were retained based on the criteria listed in Step 2.

Phase 2, the baseline HHRA, was performed for those media with COPCs identified in the HHRS, and was comprised of the following components:

- **Identification of COPCs** – Identification of the chemicals found onsite and selection of the COPCs. The COPCs are the focus of the subsequent evaluation in the risk assessment. The COPCs are identified by comparing the site data to the screening levels identified in Step 1 of the Phase 1 HHRS process.
- **Exposure Assessment** – Identification of the potential pathways of human exposure, and estimation of the magnitude, frequency, and duration of these exposures. The exposure assessment identified the exposure factors used to estimate intake of the COPCs (i.e., the ingestion rate of groundwater for each receptor exposed to groundwater, the exposed skin surface area in contact with groundwater for each receptor exposed to groundwater, etc.) and estimated the exposure point concentrations (i.e., the concentration of the COPC in groundwater that each receptor would be exposed to).
- **Toxicity Assessment** – Compilation of the toxicity values used for developing numerical risk estimates for the COPCs. The toxicity values used in the HHRA were current at the time the HHRA was prepared and were obtained from USEPA databases (such as the Integrated Risk Information System and the Provisional Peer-Reviewed Toxicity Values databases).
- **Risk Characterization** – Integration of the results of the exposure and toxicity assessments to develop numerical estimates of health risks, and comparison of the calculated carcinogenic risks and non-carcinogenic hazards for each potential human receptor to USEPA's target carcinogenic risk range of 1×10^{-6} to 1×10^{-4} and target non-carcinogenic hazard level of 1.
- **Uncertainty Assessment** – Identification and discussion of sources of uncertainty in the risk assessment.

Potential exposure pathways evaluated in the HHRA include the following:

- Contact with surface soil (current adult, youth, and child visitors/trespassers from nearby residential areas and site buildings)
- Contact with combined surface and subsurface soil (current occasional site workers who occasionally excavate loads of sand and dirt from the Base borrow pit, future industrial workers if site developed for industrial use, adult and child residents if site developed for residential use, and future construction workers)
- Contact with groundwater during construction or excavation activities (future construction workers)
- Contact with groundwater used as a potable water supply (future adult and child residents)
- Contact with surface water and sediment (current and future adult, youth, and child recreational users)

The results of Phase 1, the HHRS, are summarized in **Table 7**. The HHRS identified COPCs for surface water, and groundwater in three temporary monitoring wells; therefore, surface water and groundwater were evaluated in Phase 2, the baseline HHRA.

Phase 2 – HHRA

The baseline HHRA evaluated potential risks associated with exposure to surface water and groundwater, which were carried forward from the HHRS. The COPCs evaluated in the HHRA for each of these media are the COPCs identified in Step 1 of the HHRS. Non-carcinogenic hazards and carcinogenic risks calculated in the HHRA for exposure to surface water by recreational users were within USEPA's target HI and risk management range.

TABLE 7
Site UXO-06 HHRS Summary

Media	Receptor	Step 1 COPCs	Step 2 COPCs	Step 3 COPCs	Conclusion
Surface Soil	Current Occasional Site Worker Current Trespasser Current Recreational User Future Industrial Worker Future Resident Future Recreational User ¹ Future Construction Worker	Aluminum Arsenic Iron Thallium	None	Not applicable, no Step 2 COPCs	Exposure to soil and sediment within the site boundary would not result in any potentially unacceptable risks to human health. COPCs were identified for groundwater and surface water; therefore, groundwater and surface water were evaluated in the baseline HHRA (see Phase 2 discussion below).
Subsurface Soil	Future Site Worker Future Resident Future Construction Worker	Arsenic	None	Not applicable	
Groundwater	Future Resident Future Construction Worker	Methylene chloride bis(2-Ethylhexyl) phthalate Antimony Arsenic Cobalt Iron Manganese Nickel Thallium	bis(2-Ethylhexyl) phthalate Antimony Arsenic Cobalt Iron Manganese Thallium	bis(2-Ethylhexyl) phthalate Antimony Arsenic Cobalt Iron Manganese Thallium	
Surface Water	Current/Future Recreational Users	bis(2-Ethylhexyl) phthalate 4,4'-DDT Dieldrin Aluminum Iron Thallium Vanadium	Not evaluated – surface water COPCs not screened using RSLs	Not applicable	
Sediment	Current/Future Recreational Users	Aluminum Arsenic Chromium Cobalt	None	Not applicable	

¹ Although the recreational user was not identified as a receptor in the RI report, there would be no unacceptable risk for the recreational user exposed to surface soil since there are no unacceptable risks for the residential receptor, which is the most conservative scenario.

The RI HHRA determined that potential future potable use of groundwater by future residents could result in non-carcinogenic hazards and/or carcinogenic risks above USEPA's target HI and risk management range. The potential reasonable maximum exposure non-carcinogenic hazards were associated with iron, manganese, arsenic, and/or thallium in three of the temporary monitoring wells. Permanent monitoring wells were installed to further evaluate total metals concentrations in temporary wells. The concentrations of all metals in these permanent monitoring wells were less than the concentrations in the temporary wells and were less than the human health screening levels or background concentrations, and no COPCs were identified in the permanent monitoring wells. Therefore, although COPCs were identified in temporary wells, use of these wells to evaluate risks for future exposure scenarios likely overestimates actual potential risks, as the permanent monitoring wells are more representative of concentrations in potential potable water supplies from these areas. Additionally, the one COPC identified for MR06-TW03, iron, is a required human nutrient. The concentration of iron in MR06-TW03 would result in intake levels less than the tolerable upper intake level, which is the highest level of daily nutrient intake that is likely to pose no risk of adverse health effects to almost all individuals in the general population, for iron. Therefore, these additional evaluations and lines of evidence indicate potable use of groundwater would not result in any unacceptable risk to future residents.

Based on the HHRS and HHRA, there are no unacceptable risks associated with exposure to site media by potential current or future human receptors at Site UXO-06. The future land use is not expected to change from current use, except in the borrow pit area where recreational use is under consideration.

2.6.2 Site Risks – Ecological

Data from previous investigations within Site UXO-06 were used to conduct an ERS. Analytical data for constituents in surface soil, subsurface soil, groundwater, surface water, and sediment were screened against ecological screening values (ESVs) intended to be protective of ecological receptors. ESVs were selected from the following sources:

- USEPA [Region 4 ESVs](#)
- USEPA [Ecological Soil Screening Levels](#)
- [National Recommended Water Quality Criteria set](#)

Potential ecological receptors include: plants, soil invertebrates, benthic invertebrates, amphibians, fish, mammals, reptiles, and birds. For each sample medium, an initial hazard quotient (HQ) was calculated by dividing the maximum concentration (or maximum detection limit for non-detected analytes) by the ESV. If the initial HQ exceeded 1, additional evaluation using the average concentration compared to the ESV was conducted as part of a refined screening. An HQ greater than 1 in the refined screening suggests the potential for risk.

Additional lines of evidence used in the ERS to evaluate potential risk included background concentrations for metals, frequency of detection, magnitude of exceedance, and whether a constituent is a known laboratory contaminant. The ERS concluded that there were no unacceptable risks to ecological receptors from exposure to surface and subsurface soil, groundwater, surface water, and sediment. A summary of the ERS is provided in **Table 8**.

TABLE 8
Site UXO-06 ERS Summary

Constituent	Rationale for Identification as COPC	Conclusion
PA/SI ERS		
Surface Soil		
Aluminum	HQ greater than 1	No significant risk because average aluminum concentration at Site UXO-06 (2,493 mg/kg) was less than background.
Antimony	HQ greater than 1	No significant risk because all the detections were less than the USEPA Region 4 ESV (3.5 mg/kg).
Iron	HQ greater than 1	No significant risk because average iron concentration at Site UXO-06 (1,290 mg/kg) was less than background.
Selenium	HQ greater than 1	No significant risk because of a low magnitude of exceedance.
Pyrene	HQ greater than 1	No significant risk because of low frequency of detection (1 out of 25 samples).
Multi-incremental Surface Soil		
Aluminum	HQ greater than 1	No significant risk because it is consistent with background.
Antimony	HQ greater than 1	No significant risk because exceedances are isolated.
Cadmium	HQ greater than 1	No significant risk because of a low magnitude of exceedance.
Iron	HQ greater than 1	No significant risk because it is consistent with background.
Subsurface Soil		
Bis(2-ethylhexyl)phthalate	HQ greater than 1	No significant risk because this is a common laboratory contaminant.
Aluminum	HQ greater than 1	No significant risk because it is consistent with background.
Iron	HQ greater than 1	No significant risk because it is consistent with background.
Groundwater		
Bis(2-ethylhexyl)phthalate	HQ greater than 1	No significant risk because this is a common laboratory contaminant.
Aluminum	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.
Iron	HQ greater than 1	No significant risk because iron did not exceed regulatory screening criteria in any other medium and is not thought to be site-related.
Silver	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.
Thallium	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.
Surface Water		
Bis(2-ethylhexyl)phthalate	HQ greater than 1	No significant risk because this is a common laboratory contaminant.
4,4-DDT	HQ greater than 1	No significant risk due to the low frequency of detection (1/7), the low concentrations (all 0.01 µg/L), and the fact that pesticides were not identified as posing a risk in any other medium.
Aluminum	HQ greater than 1	No significant risk because magnitude of exceedance was low based on dissolved samples.
Cadmium	HQ greater than 1	No significant risk because cadmium was detected in only one filtered sample, at a concentration less than the ESV.
Chromium	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.

TABLE 8
Site UXO-06 ERS Summary

Constituent	Rationale for Identification as COPC	Conclusion
Iron	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was less than the ESV in dissolved sample.
Lead	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.
Thallium	HQ greater than 1	No significant risk because HQ exceedance based on total, but contaminant was not detected in dissolved sample.
Sediment		
Cadmium	HQ greater than 1	No significant risk because the average concentration for cadmium is less than the ESV.
Focused SI - Armory MILCON ERS		
Soil		
Total petroleum hydrocarbons	HQ greater than 1	Risks to the terrestrial environment associated with these constituents are likely minimal. Most concentrations are less than background, are well below a host of other screening values, or are not toxic except in extremely alkaline or acidic soil.
Dieldrin	HQ greater than 1	
Endrin	HQ greater than 1	
Aluminum	HQ greater than 1	
Chromium	HQ greater than 1	
Iron	HQ greater than 1	
Manganese	HQ greater than 1	
Vanadium	HQ greater than 1	
Groundwater		
Toluene	HQ greater than 1	Risks to the aquatic environment associated with these constituents is not considered significant. Aquatic organisms are not directly exposed to groundwater, thus concentrations in groundwater do not necessarily reflect concentrations to which aquatic organism would be exposed in the environment, i.e., the risk is overstated. Additionally, for several of the constituents exceeding North Carolina and USEPA Region 4 screening values, these constituents do not exceed many alternate screening values or National Recommended Ambient Water Quality Criteria.
Bis(2-ethylhexyl)phthalate	HQ greater than 1	
Iron	HQ greater than 1	
Zinc	HQ greater than 1	
Focused PA/SI – Onslow Water and Sewer Authority Risk Review		
Soil		
None	Not applicable	A review of the data indicates that ecological risk is low. Organic analytes were generally non-detect and when detected, were detected infrequently, were less than ESVs, and/or were attributed to field or laboratory contamination (acetone). Additionally, detected metals were generally either consistent with background or less than ESVs.
Focused SI - BPEA ERS		
Soil		
Lead	HQ greater than 1	Lead only exceeded the BTV in one of four samples. Additionally, the lead screening level is less than background, suggesting it is highly conservative. Because the extent of elevated lead is likely limited to a small area, risk from lead was considered low.

2.6.3 Site Risks – Explosive Hazards

An assessment of the relative risks posed to human receptors by MEC/MPPEH potentially present at each of the Site UXO-06 areas was conducted using the **Operational Risk Management (ORM)** and **MEC Hazard Analysis (HA) methodologies** (Appendix A and B of the FS). The potential hazard due to MEC/MPPEH remaining at each area of the site (**Table 9**) is as follows:

- Borrow Pit Area – This area was subdivided into two areas, as shown on **Figure 1**, because the southernmost portion was not investigated and has not yet been excavated.
 - Borrow Pit Area A – Area where most of the MEC/MPPEH items within Site UXO-06 were found. Although the Mishap Probability and Hazard Severity scores result in a Risk Assessment Code (RAC) of 3 (moderate) and the MEC HA Hazard Level for current use activities is 2 (high potential explosive hazard conditions), this area is judged to have a minor explosive hazard because a 100 percent investigation was conducted within Borrow Pit Area A, Borrow Pit Area A has been excavated to a depth below which munitions would be expected to be present, and borrow pit workers receive UXO safety awareness training.
 - Borrow Pit Area B – Only a small portion of this area was investigated. SAA and four other MPPEH items (signal devices and practice rockets) were found. No MEC was found. The Mishap Probability and Hazard Severity scores result in a RAC of 2 (serious) and the MEC HA Hazard Level for current use activities is 2 (high potential explosive hazard conditions). This area is judged to have a serious explosive hazard because MEC/MPPEH could potentially remain on the ground surface and in the subsurface, the area was not 100 percent investigated, the area is fully accessible, and UXO items similar to those found in Borrow Pit Area A are suspected to be present in this area.
- Cantonment Area – This area was subdivided into three areas, as shown on **Figure 1**, based on the types of MEC/MPPEH items found and their explosive hazards.
 - Cantonment Area A – Approximately 10 percent of this area was investigated, and only SAA and one other MPPEH item (ammunition can) were found. No MEC was found. The Mishap Probability and Hazard Severity scores result in a RAC of 5 (negligible) and the MEC HA Hazard Level for current use activities is 4 (low potential explosive hazard conditions). This area is judged to have a negligible explosive hazard because of a low probability of MEC/MPPEH being present, a low probability for contact with MEC/MPPEH except during planned intrusive work, and a low probability of accidental functioning if contact were to occur.
 - Cantonment Area B – Approximately 10 percent of this area was investigated and four MPPEH items resulting from practice rockets and signaling devices were found. The Mishap Probability and Hazard Severity scores result in a RAC of 3 (moderate) and the MEC HA Hazard Level for current use activities is 3 (moderate potential explosive hazard conditions). Since this area was not 100 percent investigated, it is judged to have a moderate explosive hazard because contact may occur in time.
 - Cantonment Area C – Three MEC items and five MPPEH items were found; however, the accessible areas were 100 percent investigated in support of MILCON projects. The Mishap Probability and Hazard Severity scores result in a RAC of 4 (minor) and the MEC HA Hazard Level for current use activities is 4 (low potential explosive hazard conditions). This area is judged to have a minor explosive hazard because there is a low probability for contact with MEC within the 100 percent investigation area and a low probability of accidental functioning of MEC if contact were to occur.
- Wooded Area – Approximately 10 percent of this area was investigated. No MEC items were found in this area; however, 541 MPPEH items (inert items, ordnance parts, or ordnance fragments) were found at depths up to 5 feet bgs. The Mishap Probability and Hazard Severity scores result in a RAC of 3 (moderate) and the MEC HA Hazard Level for current use activities is 2 (high potential explosive hazard conditions). Since this area was not 100 percent investigated, it is judged to have a moderate explosive hazard because contact may occur in time. If contact were to occur, there is a moderate probability of accidental functioning of MEC/MPPEH.

TABLE 9

Summary of Potential Explosive Hazards

		Borrow Pit Area		Cantonment Area			Wooded Area	Limited Use Area
		A	B	A	B	C		
Area (acres)		111	3	80	8	8	149	91
Percent of Area Investigated		47.3 percent (100 percent of BPEA)	Negligible ^a	10 percent	10 percent	100 percent	11.9 percent	Not Investigated
Site Factors		Access limited to authorized workers; unauthorized access unlikely/infrequent due to lack of attractions	Access limited to authorized workers; unauthorized access unlikely/infrequent due to lack of attractions	Accessible to Base personnel and visitors who primarily use paved roads and sidewalks			Limited access due to thick vegetation except for physical training trails	Low to no access due to wetlands and heavy vegetation
Human Factors		Contractors trained in UXO safety awareness	Contractors trained in UXO safety awareness	Base personnel, Visitors			Base personnel, Hunters	Hunters
Ordnance Factors	MEC items found (fillers)	15 mostly in center of area (High Explosive, pyrotechnics)	0	0	0	3 (pyro-technic, practice)	0	NA
	MPPEH items found (excluding SAA; all expended, no filler)	2,178 mainly in center of area	4	1 (ammunition can)	4	5	541 mainly in eastern portion of area	NA
	SAA items found	11 locations (20 items)	4 locations (7 items)	66 locations (123 items)	2 locations (137 items)	7 locations (30 items)	159 locations (6,149 items) ^b	NA
	Depth of MEC/MPPEH (inches)	Subsurface (2-40)/ Surface and Subsurface (0-48)	None/ Subsurface (1-8)	None/ Subsurface (1-14)	None/ Subsurface (8-24)	Subsurface (2-10)/ Subsurface (2-22)	None/ Surface and Subsurface (0-60)	NA
ORM Risk Assessment Code (RAC) ^c		Moderate (3) ^d	Serious (2)	Negligible (5)	Moderate (3)	Minor (4)	Moderate (3)	Minor (4)
MEC HA Score for Current Use Scenario (Hazard Level)		755 (2)	755 (2)	415 (4)	680 (3)	445 (4)	755 (2)	755 (2)

^a A small portion of one transect from the RI extended into Borrow Pit Area B.

^b Includes cache of 5,500 items.

^c The RAC is the outcome of the hazard assessment step of the ORM process, where the associated degree of risk for each area is identified in terms of probability and severity (Chief of Naval Operations Instruction 3500.39C).

^d The explosive hazard for the Borrow Pit Area was listed as moderate in the RI Report based only on the RAC score; however, after re-evaluating the site, human, and ordnance factors, the area is considered to pose a minor explosive hazard as discussed above.

- Limited Use Area – Although this area was not investigated, the types of munitions items that may be encountered are expected to be similar to those items found in the Wooded Area. The Mishap Probability and Hazard Severity scores result in a RAC of 4 (minor) and the MEC HA Hazard Level for current use activities is 2 (high potential explosive hazard conditions). This area is considered to have a minor explosive hazard because of a low probability for contact with MEC/MPPEH because of access limitations even though there is a moderate probability of accidental functioning of MEC/MPPEH if contact were to occur.

2.6.4 Basis for Response Action

Based on the explosive hazard evaluation, there is an unacceptable risk from potential exposure to explosive hazards from MEC/MPPEH at the remediation target areas of Site UXO-06 (**Figure 2**):

- Borrow Pit Areas A and B because they have been identified for use for borrow pit operations and some portions were not investigated
- The portion of Cantonment Area C south of Gonzalez Boulevard where MEC items were found consistent with former training activities that were conducted south of the Cantonment Area
- Cantonment Area B, the Wooded Area, and Limited Use Area to address potential threats from any MEC/MPPEH that potentially remain

It is the current judgment of the Navy, USMC, and USEPA, in concurrence with NCDEQ, that the response action selected in this ROD is necessary to protect public health or welfare or the environment from exposure to MEC/MPPEH that may present an endangerment to public health or welfare or the environment.

2.7 Principal Threat Wastes

MEC, specifically discarded military munitions or UXO, if any, remaining at MCB Camp Lejeune may constitute a principal threat to human health at Site UXO-06, OU 24, because of the explosive hazard that could result in injury or death. MEC found during previous investigations was determined to be a principal threat waste (PTW) and was treated onsite by intentional detonation in accordance with the approved [Explosives Safety Submissions](#) (ESSs) at the time: *ESS for Munitions Response Activities, Site UXO-06 Former Fortified Beach Assault Area* and *ESS for Munitions Response Activities, Site UXO-06 (ASR# 2.65 D-7)/Operable Unit 24 Adjacent Investigation Area*. If MEC is later encountered in those areas, MCB Camp Lejeune EOD or UXO-qualified personnel will evaluate the material to determine if it poses an explosive hazard. The Navy and USEPA will consult, in accordance with the terms of the MCB Camp Lejeune FFA, to make a determination as to whether the material should be classified as a PTW per the PTW guidance (Office of Solid Waste and Emergency Response 9380.3-06FS, November 1991) and the NCP expectation that principal threats are treated wherever practicable. (Ref 40 CFR 300.430(a)(1)(iii)(A)).

If the material is determined to be a PTW, the Navy will take all necessary actions to ensure the protectiveness of human health and the environment to address unacceptable risks posed by the material designated as a PTW.

2.8 Remedial Action Objective

In order to be protective of human health and the environment and to address potential explosive hazards, the Remedial Action Objective (RAO) identified for the remediation target areas (**Figure 2**) of Site UXO-06 is to:

- Reduce or prevent the potential for direct physical contact with MEC/MPPEH, which can present unacceptable risk to human health and safety due to the explosive nature of the items/materials.

2.9 Description and Comparative Analysis of Remedial Alternatives

2.9.1 Description of Remedial Alternatives

The remedial alternatives that were developed and evaluated to address potential MEC/MPPEH on the surface and in the subsurface at Site UXO-06 are detailed in the FS. A summary of remedial alternatives is presented in **Table 10**.

TABLE 10
Summary of Remedial Alternatives for Site UXO-06

Alternative	Components	Details	Cost//Timeframe	
1 – No Action	None	None	Total Cost Timeframe	\$0 Not applicable
2 – LUCs	LUCs	<p>LUCs are required because MEC/MPPEH may be present; the following will be done to reduce potential contact with surficial or buried MEC/MPPEH.</p> <p>Borrow Pit Area A</p> <ul style="list-style-type: none"> Intrusive Activities Control - Require on-call UXO construction support for any intrusive activities. Require UXO safety awareness training for Base non-EOD and non-UXO-qualified personnel and contractors. Provide educational support to inform onsite personnel and contractors about the implemented LUCs at the site. Access Control - Install warning signs that notify authorized personnel, and potential future users such as Base personnel and/or the public and reduce the potential for trespassers to come into contact with MEC/MPPEH that may be present on the site. <p>Cantonment Area B</p> <ul style="list-style-type: none"> Intrusive Activities Control – Require UXO construction support for any intrusive activities. Require UXO safety awareness training for Base non-EOD/UXO personnel and contractors. Provide educational support to inform onsite personnel and contractors about the implemented LUCs at the site. <p>Cantonment Area C south of Gonzalez Boulevard</p> <ul style="list-style-type: none"> UXO Safety Awareness Program – Require UXO safety awareness training for Base non-EOD and non-UXO-qualified personnel and contractors. 	<p>Option A</p> <p>Capital Cost \$600,000</p> <p>Total Periodic Cost \$800,000</p> <p>Total Present Value Cost \$1,300,000</p> <p>Cost Estimate Timeframe 30 Years</p>	
		<p>Borrow Pit Area B, Wooded and Limited Use Areas</p> <ul style="list-style-type: none"> Intrusive Activities Control (see Cantonment Area B above) Industrial/Non-Industrial Use Control - Require site approval if new buildings are to be constructed or if land use changes; this includes evaluating the need for MEC clearance and/or UXO construction support. Prohibit non-industrial land use; this includes prohibiting the construction of residential housing, hospitals, hotels, nursing homes, and day care facilities. Access Control – Physical barriers such as fencing and warning signs to reduce the potential for potential future users such as Base personnel and/or the public, recreational users, and trespassers to come into contact with MEC/MPPEH that may be present on the site. <p>The access control options for Borrow Pit Area B, Wooded Area, and Limited Use Area are as follows:</p> <ul style="list-style-type: none"> Option A – Fencing would be installed along high traffic areas. Signs would be posted at targeted access points for the borrow pit, physical training areas, and Base-identified locations. 	<p>Option A</p> <p>Capital Cost \$600,000</p> <p>Total Periodic Cost \$800,000</p> <p>Total Present Value Cost \$1,300,000</p> <p>Cost Estimate Timeframe 30 Years</p> <p>Option B</p> <p>Capital Cost \$300,000</p> <p>Total Periodic Cost \$800,000</p> <p>Total Present Value Cost \$1,000,000</p> <p>Cost Estimate Timeframe 30 Years</p>	

TABLE 10
Summary of Remedial Alternatives for Site UXO-06

Alternative	Components	Details	Cost//Timeframe	
		<ul style="list-style-type: none"> Option B – Signs would be posted around the perimeter of the remediation target areas. No fencing would be installed. 		
3 – Surface MEC Clearance and LUCs	MEC Surface Clearance	Removal of MEC/MPPEH on the ground surface in accessible areas of Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area. UXO qualified-personnel would conduct an instrument-assisted visual inspection of the ground surface to identify potential MEC/MPPEH items. Upon discovery, MEC/MPPEH would be disposed of.	Capital Cost ^a Total Periodic Cost Total Present Value Cost Cost Estimate Timeframe	\$1,000,000 \$800,000 \$1,800,000 30 Years
	LUCs	LUCs, as described in Alternative 2, would be implemented within both the accessible and inaccessible areas.		
4 – Surface and Subsurface MEC Clearance (removal of discrete anomalies) and LUCs	Anomaly Reacquisition and Clearance	Removal of MEC/MPPEH from the ground surface and to a depth of 4 feet bgs within the accessible areas of Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area as follows: <ul style="list-style-type: none"> Surface MEC clearance as described under Alternative 3, resulting in the identification and removal of MEC/MPPEH on the ground surface. Subsurface MEC clearance would be conducted using DGM or analog detectors to identify anomalies that represent potential subsurface MEC/MPPEH. 	Capital Cost ^a Total Periodic Cost Total Present Value Cost Cost Estimate Timeframe	\$5,200,000 \$700,000 \$5,800,000 30 Years
	LUCs	LUCs, as described in Alternative 2, would be implemented within both the accessible and inaccessible areas. Following completion of the MEC clearances, UXO construction support, as described under Alternative 2, would be required for ground-disturbing activities below 1.5 feet bgs to 4 feet bgs within the accessible areas.		
5 – Surface and Subsurface MEC Clearance (removal via excavation and soil screening) and LUCs	MEC Clearance	Removal of MEC/MPPEH from the ground surface and to a depth of 4 feet bgs in the accessible areas of Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area would be conducted as follows: <ul style="list-style-type: none"> Surface MEC clearance as described under Alternative 3, resulting in the identification and removal of MEC/MPPEH on the ground surface. Subsurface MEC clearance resulting in the removal of MEC/MPPEH using soil excavation and screening equipment. 	Capital Cost ^a Total Periodic Cost Total Present Value Cost Cost Estimate Timeframe	\$9,400,000 \$400,000 \$9,700,000 30 Years
	LUCs	LUCs, as described in Alternative 2, would be implemented within both the accessible and inaccessible areas. UXO construction support would not be needed in the accessible areas.		

^a For cost estimating purposes, Alternatives 3 through 5 assumed Alternative 2 Option B for access controls.

2.9.2 Comparative Analysis of Alternatives

A comparative analysis using the **nine USEPA criteria** was completed and is discussed in this section. The analysis is summarized in **Table 11**.

TABLE 11

Comparative Analysis of Alternatives

CERCLA Criteria	Alternative				
	(1) ^a	(2)	(3)	(4)	(5)
Threshold Criteria					
Protection of human health and the environment	○	●	●	●	●
Compliance with ARARs	○	●	●	●	●
Primary Balancing Criteria					
Long-term effectiveness and permanence	NA	●	●	●	●
Reduction in toxicity, mobility, or volume through treatment	NA	○	●	●	●
Short-term effectiveness	NA	●	●	●	○
Implementability	NA	●	●	●	○
Present Worth Cost	\$0	\$1.0 - 1.3 M ^b	\$1.8 M ^c	\$5.8 M ^c	\$9.7 M ^c

Notes:

Alternative 1: No Action

Alternative 2: LUCs

Alternative 3: Surface MEC Clearance and LUCs

Alternative 4: Surface MEC Clearance, Subsurface MEC Clearance through Removal of Discrete Anomalies, and LUCs

Alternative 5: Surface MEC Clearance, Subsurface MEC Clearance through Excavation and Soil Screening, and LUCs

Ranking: ● High (favorable) ● Moderate ○ Low (unfavorable)

Rankings are provided as qualitative descriptions of the relative compliance of each alternative with the criteria.

^a The No Action alternative is used as a baseline for comparison purposes only. Because it does not meet the threshold criteria, it is not a viable alternative for this site and was not further evaluated.

^b The low end of the range for Alternative 2 is Option B and the high end is Option A.

^c For cost estimating purposes, Alternatives 3 through 5 assumed Alternative 2 Option B.

NA = Not Applicable

Threshold Criteria

Overall Protection of Human Health and the Environment

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

Alternative 2 (LUCs) is more protective of human health and the environment than Alternative 1 (No Action) because LUCs provide awareness of potential UXO hazards that can result in injury from encounters with any remaining subsurface MEC/MPPEH. The LUCs would provide information about UXO Safety Awareness for educational purposes and potentially deter unauthorized visitors.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

All alternatives, except for Alternative 1 (No Action), are protective of human health and the environment by reducing or controlling risks posed by the site through remedial strategies and/or LUCs. Alternatives 2, 3, 4, and 5 are protective of human health and the environment because LUCs would reduce exposure to any remaining

surface and subsurface MEC/MPPEH. A MEC Surface Clearance (Alternatives 3, 4, and 5) and subsurface clearance (Alternatives 4 and 5) would provide further protection beyond those provided by the LUCs.

The intrusive anomaly investigations conducted to-date have reduced the potential risks from encountering MEC/MPPEH at portions of the site but have not been conducted over all of the accessible portions of the site. Although Alternatives 3, 4, and 5 would involve actions to further reduce the risk of encountering MEC/MPPEH within the accessible areas, 100 percent removal of MEC/MPPEH cannot be guaranteed. A moderate risk would remain after Alternative 3 is completed because MEC/MPPEH removal would be limited to the ground surface. A low to moderate risk of explosive hazard also would remain after Alternatives 4 and 5 were implemented because removal actions are not 100 percent effective at removing MEC/MPPEH. Therefore, LUCs would still be needed to prevent exposure for Alternatives 3, 4, and 5.

Compliance with ARARs

Remedial actions for cleanup of hazardous substances must comply with the ARARs, (the federal and more stringent state environmental laws, rules, or regulations that must be met [or waived] by the selected remedy under CERCLA Section 121(d). (See 40 CFR 300.5).

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

Alternative 2 is expected to comply with ARARs, and it is not anticipated that any waivers will be required for this alternative. A Notice of Contaminated Site will be implemented as part of Alternative 2 in accordance with North Carolina law.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

Alternatives 2, 3, 4, and 5 are expected to comply with ARARs, and it is not anticipated that any waivers will be required for these alternatives. A Notice of Contaminated Site will be implemented as part of Alternatives 2, 3, 4, and 5 in accordance with North Carolina law. Additional action- and location-specific ARARs apply to Alternatives 3, 4, and 5 based on earth-moving activities and the potential for MEC/MPPEH to be encountered, requiring management and disposal.

Primary Balancing Criteria

Alternative 1, No Action, did not meet the threshold criteria and therefore is not eligible for selection and was not included in the evaluation.

Long-term Effectiveness and Permanence

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

Alternative 2 for Borrow Pit Area A is effective in the long-term because most of this area has been excavated to a depth below which munitions are expected to be found and because the public and Base personnel are notified through UXO Safety Awareness signs. Alternative 2 for Cantonment Area C south of Gonzalez Boulevard is also effective in the long-term because a 100 percent investigation was conducted in this area in support of MILCON. Additionally, Alternative 2 is effective in the long-term for both areas because the public and Base personnel are informed through UXO Safety Awareness training of possible explosive hazards. The LUCs are effective and adequate for both Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard in providing continued protection from explosive hazards as long as they are maintained and enforced. LUCs would be susceptible to changes in Base policy and enforcement, and would be required in perpetuity. CERCLA Five-Year Reviews also would be required.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

Each alternative provides some degree of long-term protection that increases if MEC/MPPEH removal is included. Alternatives 2 and 3 are least effective because no more subsurface MEC/MPPEH is removed. Alternatives 4 and 5 offer an increased level of effectiveness in the long-term because they would involve the permanent removal of surface and/or subsurface MEC/MPPEH throughout the accessible areas of the site, which minimizes the potential for exposure over time. Alternative 3 would remove the least amount of MEC/MPPEH (relative to Alternatives 4

and 5) since it relies on visual inspection of the ground surface where MEC/MPPEH can be buried under vegetative debris and does not address subsurface MEC/MPPEH. Alternative 4 includes removing subsurface MEC/MPPEH, but removing 100 percent of subsurface MEC/MPPEH cannot be guaranteed in this alternative. The MEC/MPPEH removal for Alternative 5 is virtually 100 percent, since all the MEC/MPPEH that is equal to or larger than the selected screen size would be removed.

Although LUCs would be required to minimize uncontrolled exposure to MEC/MPPEH that potentially remains for Alternatives 2, 3, 4, and 5, the LUCs would be less restrictive for Alternatives 4 and 5 because the removal of MEC/MPPEH would be conducted below the surface at depths where MEC/MPPEH would most likely be encountered. Reviews at least every 5 years, or as required, would be necessary to evaluate the effectiveness of any of the alternatives because hazards would remain onsite above levels that allow for unlimited use and unrestricted exposure.

Reduction of Toxicity, Mobility, or Volume through Treatment

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

There would be no reduction in toxicity, mobility, or volume through implementation of Alternative 2 because no treatment technologies would be employed.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

Alternatives 3, 4, and 5 achieve reduction of toxicity, mobility, or volume through treatment because they include the treatment (demolition) of surface (Alternatives 3, 4, and 5) and subsurface (Alternatives 4 and 5) MEC/MPPEH removed from within accessible areas of the site. The amount of MEC/MPPEH removed under Alternative 3 is considerably less than the amount removed under Alternatives 4 and 5 since this alternative would only address surface MEC/MPPEH. The MEC/MPPEH removal amount from Alternative 4 would be subject to the detection technology but would result in a larger amount of removal than Alternative 3. Alternative 5 would remove the largest amount of MEC/MPPEH because soil within the accessible areas would be screened. There would be no reduction in toxicity, mobility, or volume through implementation of Alternative 2 because no treatment technologies would be employed.

Short-term Effectiveness

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

Short-term risks to workers, the community, and the environment, as well as the time to implement the remedy would be favorable for Alternative 2. Physically installing the signs that are part of the LUCs for Borrow Pit Area A requires minimal labor and equipment. Risks to workers from intrusive work for sign installation would be mitigated with MEC avoidance supported by UXO-qualified personnel. Risks to workers also would be minimal because heavy equipment would not be involved. Alternative 2 also has a low potential impact to the environment during implementation, and a short implementation timeframe because only LUCs would be implemented.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

Short-term risks to workers, the community, and the environment, as well as the time to implement the remedy would be the most favorable for Alternatives 2 and 3. Installing the signs that are part of the LUCs for Borrow Pit Area B, Wooded Area, and Limited Use Area and conducting a surface clearance require minimal labor and equipment. Risks to workers would be minimal because no heavy equipment would be involved. For the same reason, the overall environmental impact would be minimal as well. Risks to workers from intrusive work for sign installation would be mitigated with MEC avoidance supported by UXO-qualified personnel, and UXO-qualified personnel would perform the surface clearance. Alternative 2 also has the lowest potential impact to the environment during implementation, and shortest implementation time frame since no active treatment would be performed, only LUCs.

Alternatives 4 and 5 have higher short-term risks to workers, the community, and the environment associated with the MEC/MPPEH removal effort. Additional potential risks also are present for Alternatives 3, 4, and 5 because of the explosives used for demolition of MEC/MPPEH.

Alternative 4 requires a moderate number of labor hours and minimal equipment. There also would be a low to moderate impact on the environment during implementation because of the implementation time frame and personal transportation. Implementation of Alternative 4 within Cantonment Area B is easier to achieve with minimal impact to the community compared to Alternative 5 since heavy equipment would not be used.

Alternative 5 requires a significant level of effort and the use of heavy equipment, and there would be hazards to workers from heavy equipment handling and unintentional detonation during vegetation clearing and excavation during the subsurface clearance activities. Alternative 5 would have the largest environmental impact because it would require the most labor hours, personal transportation, and heavy equipment. Implementation of Alternative 5 within the Cantonment Area B may be difficult and pose higher risks to the community because this area is located within a public area with vehicle and foot traffic.

Implementability

Borrow Pit Area A and Cantonment Area C south of Gonzalez Boulevard

Alternative 2 is considered technically feasible and easy to implement because LUCs are primarily an administrative action (educational support, communication of LUCs, etc.), with only minor fieldwork necessary for installing warning signs for Borrow Pit Area A and conducting inspections.

Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area

All of the alternatives are considered technically feasible to implement. Alternative 2 is considered the easiest to implement because LUCs are primarily an administrative action (educational support, communication of LUCs, etc.), with minor fieldwork for installing warning signs/fencing and inspections for Borrow Pit Area B, Wooded Area, and Limited Use Area.

Alternatives 3 and 4 are more difficult to implement than Alternative 2 because they require the coordination of large UXO teams traversing the accessible areas of the site, including Cantonment Area B where there is significant development. Alternative 5 is considered the most difficult to implement because of the need to operate and store heavy equipment onsite for a long duration (both vegetation clearance and soil excavation and screening activities) near or in the proximity of inaccessible wetlands, and because it consists of a large-scale removal action that is more complex than the other alternatives.

Cost

An order-of-magnitude cost for each alternative has been estimated based on a variety of key assumptions. Costs and remedy components that were used in the cost estimate are listed in **Table 10**.

The estimated present worth costs for the alternatives range from \$1 million for Alternative 2B to \$9.7 million for Alternative 5. Overall, the capital cost for Alternative 3 is low (\$1,000,000) relative to Alternatives 4 and 5. Alternative 3 does not require the need to conduct additional DGM and intrusive investigations over a large area, or the need to operate and store heavy equipment onsite for long durations. Most of the cost for Alternative 3 is based on the requirement of a large UXO team traversing the site while conducting a surface MEC clearance.

Modifying Criteria

State Acceptance

State involvement has been solicited throughout the CERCLA and remedy selection process. NCDEQ supports the Preferred Alternative, and their final concurrence is provided in **Appendix C**.

Community Acceptance

The public meeting was held on June 14, 2017, to present the Proposed Plan and answer community questions regarding the preferred remedy at Site UXO-06. No comments requiring amendment to the proposed plan were received from the public during the meeting and public comment period.

2.10 Selected Remedy

The Selected Remedy for Site UXO-06 is Alternative 3, Surface MEC Clearance and LUCs (Option B for signs).

2.10.1 Rationale for the Selected Remedy

A Surface MEC Clearance with LUCs (with Option B for signs) was selected because this alternative provides a similar level of long-term protection as Alternative 2 and achieves a reduction of toxicity, mobility, or volume through treatment of MEC/MPPEH on the surface, where it is most likely to be encountered. Implementation of Alternative 3 also is significantly less damaging to the environment, would result in lower risks to workers during implementation, would be significantly less disruptive to operations within Cantonment Areas B and C and the nearby Borrow Pit, reduces the risk sooner, and would be less expensive than Alternatives 4 and 5, both of which would require LUCs in the long-term.

2.10.2 Description of the Selected Remedy

The Selected Remedy for Site UXO-06 includes the following components as shown on **Figures 7 and 8**:

The preferred alternative consists of the following:

- Removal of MEC/MPPEH on the ground surface in accessible areas of Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use Area
- UXO construction support for all intrusive activities within all the remediation target areas except Cantonment Area C south of Gonzalez Boulevard
- 3Rs (Recognize, Retreat, Report) of Explosives Safety Education, also known as UXO Safety and Awareness Training, for all personnel working within the remediation target areas
- Warning signs around the perimeter of Borrow Pit Areas A and B, Wooded Area, and Limited Use Area
- Updates to the Base Master Plan and/or geographic information systems mapping with the LUCs
- Filing a Notice of Contaminated Site in Onslow County real property records in accordance with North Carolina General Statutes 143B-279.9 and 143B-279.10

The following LUCs (**Figure 7**) would be implemented:

- **Borrow Pit Area A**
 - **Intrusive Activities Control (Munitions and Explosives of Concern/Material Potentially Presenting an Explosive Hazard [MEC/MPPEH])** – Require on-call UXO construction support for any intrusive activities. Require 3Rs of Explosives Safety Education for non-EOD and non-UXO-qualified Base personnel and contractors. Provide educational support to inform onsite personnel and contractors about the implemented LUCs at the site.
 - **Access Control** – Install warning signs that notify authorized personnel and potential future users such as Base personnel and/or the public and to reduce the potential for trespassers to come into contact with MEC/MPPEH that may be present on the site.
- **Cantonment Area B**
 - **Intrusive Activities Control (Munitions and Explosives of Concern/Material Potentially Presenting an Explosive Hazard [MEC/MPPEH])** – Require UXO construction support for any intrusive activities. Require 3Rs of Explosives Safety Education for non-EOD and non-UXO-qualified Base personnel and contractors.

FIGURE 7
Land Use Controls

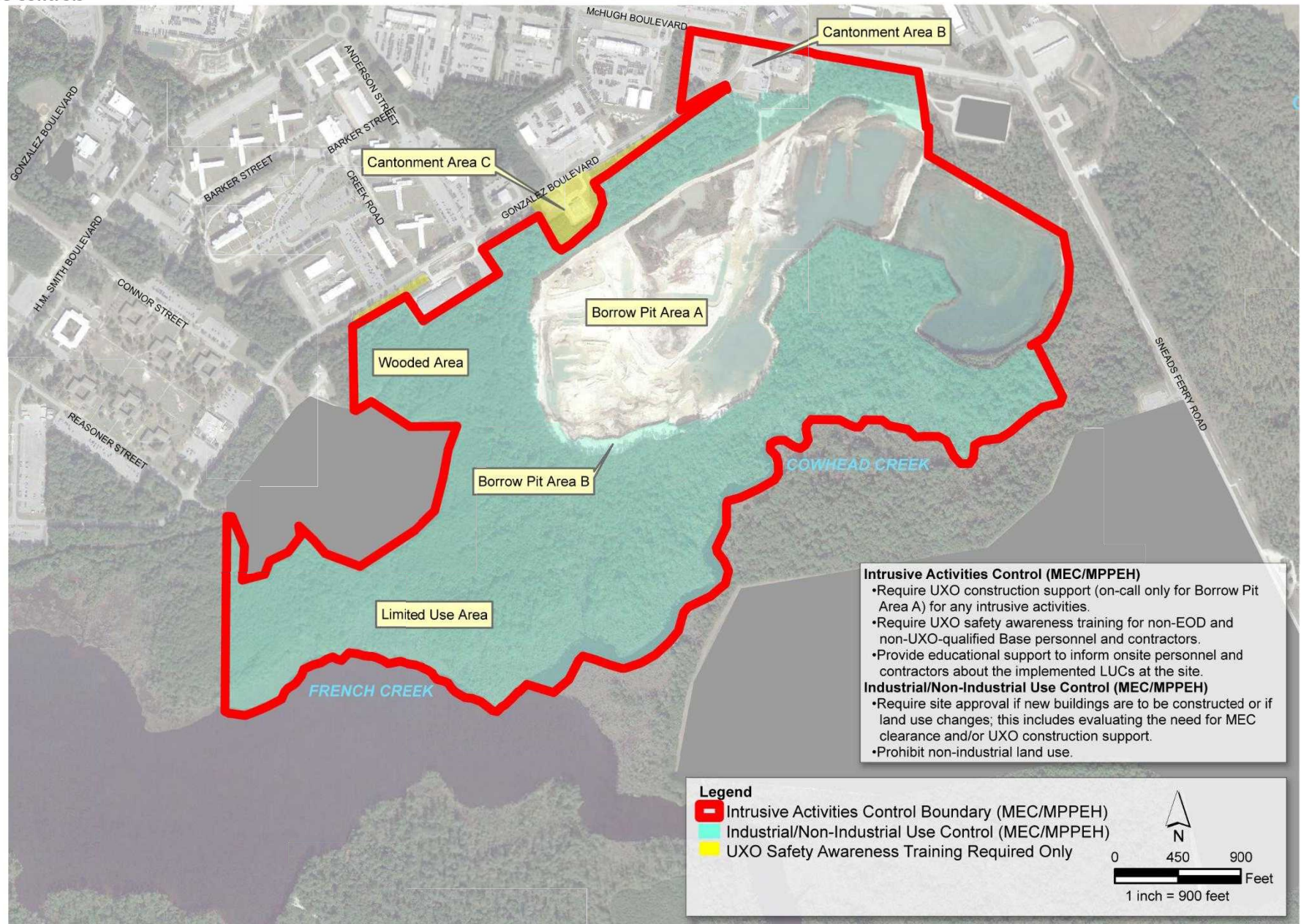


FIGURE 8
Remedial Activities



Provide educational support to inform onsite personnel and contractors about the implemented LUCs at the site.

- **Cantonment Area C south of Gonzalez Boulevard**
 - **UXO Safety Awareness Program** – Require 3Rs of Explosives Safety Education for non-EOD and non-UXO-qualified Base personnel and contractors.
- **Borrow Pit Area B, Wooded, and Limited Use Areas**
 - **Intrusive Activities Control (Munitions and Explosives of Concern/Material Potentially Presenting an Explosive Hazard [MEC/MPPEH])** – Require UXO construction support for any intrusive activities. Require 3Rs of Explosives Safety Education for non-EOD and non-UXO-qualified Base personnel and contractors. Provide educational support to inform personnel and contractors on the implemented LUCs at the site.
 - **Industrial/Non-Industrial Use Control (Munitions and Explosives of Concern/Material Potentially Presenting an Explosive Hazard [MEC/MPPEH])** – Require site approval if new buildings are to be constructed or if land use changes; this includes evaluating the need for MEC clearance and/or UXO construction support. Prohibit non-industrial land use; this includes prohibiting the construction of residential housing, hospitals, hotels, nursing homes, and day care facilities.
 - **Access Control (Option B)** – Warning signs to reduce the potential for potential future users such as Base personnel and/or the public, recreational users, and trespassers to come into contact with MEC/MPPEH that may be present on the site.

The Navy and MCB Camp Lejeune are responsible for implementing, maintaining, reporting on, and enforcing the LUCs. Although the Navy and MCB Camp Lejeune may later transfer these procedural responsibilities to another party by contract, property transfer agreement, or through other means, the Navy shall retain ultimate responsibility for the remedy. The remediation target areas and remedy components are shown on **Figures 2, 7 and 8**; the actual LUC boundaries will be finalized in the Remedial Design (RD). The LUC implementation actions, including enforcement requirements, also will be provided in a Land Use Control Implementation Plan (LUCIP) that will be prepared as part of the RD.

The Navy will submit the LUCIP and RD to USEPA and NCDEQ for review and approval pursuant to the primary document review procedures stipulated in the FFA. The Navy will maintain, monitor (including conducting periodic inspections), and enforce the LUCs according to the requirements contained in the LUCIP and the RD. LUCs will be maintained indefinitely unless additional action is taken to remove potential explosive hazards, allowing for unlimited use and unrestricted exposure.

Actual construction support requirements will be determined by the Installation's Explosives Safety Officer, Marine Corps Systems Command, and the Department of Defense Explosives Safety Board. Construction support shall be determined by submission of an ESS and/or an ESS Determination Request, in accordance with appropriate Navy and Marine Corps regulations.

Because potential explosive hazards remain and unlimited use and unrestricted exposure will not be achieved, the Navy will review the final remedial action no less than every 5 years after initiation of the remedial action, in accordance with CERCLA Section 121(c) and the NCP at 40 CFR 300.4309f)(4)(ii). If results of the 5-year reviews reveal that remedy integrity is compromised and protection of human health is insufficient, additional remedial actions would be evaluated by the parties and implemented by the Navy.

2.10.3 Expected Outcomes of the Selected Remedy

The future land use at Site UXO-06 is not expected to change from current use, except in the borrow pit area where recreational use is under consideration. A surface MEC clearance will remove any potential MEC/MPPEH from the ground surface within the accessible portions of the remediation target areas and exposure to MEC/MPPEH will be controlled through LUCs. **Table 12** summarizes the unacceptable risks, the RAO identified to

address the risks, the remedy components intended to achieve the RAO, the metrics that measure the remedial action progress, and the expected outcome of the Selected Remedy.

TABLE 12
Expected Outcomes

Risk	RAO	Remedy Component	Metric	Expected Outcome
Potential explosive hazard from contact with MEC/MPPEH	Reduce or prevent the potential for direct physical contact with MEC/MPPEH, which can present unacceptable risk to human health and safety due to the explosive nature of the items/materials.	Surface MEC Clearance and LUCs	Conduct a MEC Surface Clearance in the Borrow Pit Area B, Cantonment Area B, Wooded Area, and Limited Use remediation target areas	Continue current site use
			Maintain and monitor LUCs quarterly	

2.10.4 Statutory Determinations

Remedial actions undertaken at NPL sites must meet the statutory requirements of Section 121 of CERCLA and be protective of human health and the environment, comply with ARARs of both federal and more stringent state environmental laws and regulations unless a waiver is justified, be cost-effective, and utilize to the maximum extent practicable, permanent solutions and alternative treatment or resource recovery technologies. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, and/or mobility of hazardous waste as the principal element. The following discussion summarizes the statutory requirements that are met by the Selected Remedy.

- Protection of Human Health and the Environment** – The Selected Remedy (Surface MEC Clearance and LUCs) will protect human health and the environment by providing awareness of potential UXO hazards that can result in injury from encounters with any remaining subsurface MEC/MPPEH, warning signs, and administrative controls restricting intrusive activities in areas and at depths that have not been previously investigated. The surface MEC clearance will further reduce exposure to MEC/MPPEH by providing protection beyond those provided by the LUCs; however, a moderate risk would still remain after a surface clearance is completed because MEC/MPPEH removal would be limited to the ground surface.
- Compliance with ARARs** – Section 121(d) of CERCLA, as amended, specifies, in part, that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate to the hazardous substances or particular circumstances at a site or obtain a waiver. See also 40 CFR § 300.430(f)(1)(ii)(B). ARARs include only federal and state environmental or facility citing laws and regulations and do not include occupational safety or worker protection requirements. Compliance with Occupational Safety and Health Administration (OSHA) standards is required by 40 CFR § 300.150; therefore, the CERCLA requirement for compliance with or waiver of ARARs does not apply to OSHA standards. In addition to ARARs, the lead and support agencies may, as appropriate, identify other advisories, criteria, or guidance to-be-considered for a particular release. In accordance with 40 CFR § 300.400(g), the Navy, USEPA, and NCDEQ have identified the ARARs for the Selected Remedy. **Appendix A** lists, respectively, the location-, and action-specific ARARs and to-be-considered (TBC) criteria for the Selected Remedy. There are no chemical-specific ARARs for the Selected Remedy. The Selected Remedy will meet all identified ARARs and TBC criteria.
- Cost-effectiveness** – The Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. The following definition was used to determine cost-effectiveness: “A remedy shall be cost-effective if its costs are proportional to its overall effectiveness” (NCP §300.430[f][1][ii][D]). This analysis was accomplished by evaluating the overall effectiveness of those alternatives that satisfied the long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness. The overall effectiveness of the Selected Remedy was compared to costs to determine cost-

effectiveness. The Selected Remedy's costs were determined to be proportional to overall effectiveness, thus representing a reasonable value for the money. Additional removal action would not improve the effectiveness proportionally to the additional costs.

The estimated present-worth cost of the Selected Remedy (Alternative 3) is \$1,800,000, and the cost-estimate timeframe is predicted to be approximately 30 years. Present-worth costs for Alternatives 4 and 5 are significantly higher and are not expected to reduce the remedial timeframe because residual MEC/MPPEH may be present even after removal actions are completed.

- Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable** – The Selected Remedy achieves a reduction in volume because it includes treatment (detonation) of surface MEC/MPPEH and resource recovery (recycling of scrap or spent munitions) during surface clearance operations. Based on the current state of the industry, there is no guarantee of complete removal of MEC/MPPEH from the surface after conducting a surface clearance since it relies on minimal magnetometer screening during the walkthrough and relies on visual inspection of the ground surface where MEC/MPPEH can be covered under vegetative debris. Therefore, LUCs would be required regardless of the alternative selected.
- Preference for Treatment as a Principal Element** – The Selected Remedy, which consists of a MEC Surface Clearance and LUCs, includes onsite treatment (detonation) of surface MEC/MPPEH removed from within the accessible portions of the site, which satisfies the statutory preference for treatment. As described above, previous investigations have removed MEC/MPPEH, some of which was considered to be PTW because of the explosive hazard and was burned/ignited (i.e., treated) to effectively render it safe for disposition such as disposal.
- Five-year Review Requirements** – This remedy will result in MEC/MPPEH remaining onsite, preventing unlimited use and unrestricted exposure; therefore, in accordance with CERCLA Section 121(c) and the NCP at 40 CFR § 300.430 (f)(4)(ii), a statutory review will be conducted by the Navy within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment. If the remedy is determined not to be protective of human health and the environment because, for example, LUCs have failed, then additional remedial actions would be evaluated by the FFA parties, and the Navy may be required to undertake additional remedial action.

2.11 Community Participation

The Navy, USMC, USEPA, and NCDEQ provide information regarding the cleanup of MCB Camp Lejeune to the public through the Community Relations Program, which includes a Restoration Advisory Board, public meetings, the AR file for the site, and announcements published in local newspapers. Restoration Advisory Board meetings continue to be held to provide an information exchange among community members, the Navy, USMC, USEPA, and NCDEQ. These meetings are open to the public and are held quarterly.

In accordance with Sections 113 and 117 of CERCLA, the Navy provided a public comment period for the Site UXO-06 Proposed Plan from June 8 through July 8, 2017. A public meeting to present the Proposed Plan was held on June 14, 2017, at Coastal Carolina Community College. Public notice of the meeting and availability of documents was placed in *The Jacksonville Daily News* and *The Globe* newspapers on June 4 and June 8, 2017, respectively. The notice also was submitted to WAVQ Radio station as a public service announcement on June 1, 2017, posted to WRAL FM's community calendar (<http://www.wralfm.com/community-events>) on June 3, 2017, and posted on Marine Corps Base Camp Lejeune Facebook page (<https://www.facebook.com/camp.lejeune/>) on June 12, 2017.

The AR, Community Involvement Plan, IRP fact sheets, and final technical reports concerning Site UXO-06 can be obtained from the IRP web site: <http://go.usa.gov/Dy5T>. Internet access is available to the public at the following location:

Onslow County Public Library
58 Doris Avenue East
Jacksonville, North Carolina 28540
(910) 455-7350

2.12 Documentation of Significant Changes

The Proposed Plan for Site UXO-06 was released for public comment on June 8, 2017. No comments were submitted during the public comment period. No significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

3 Responsiveness Summary

The participants in the Public Meeting held on June 14, 2017, included representatives of the USMC, USEPA, and NCDEQ. Several community members attended the meeting. Questions received during the public meeting were general inquiries and are described in the public meeting minutes in the AR. There were no comments received at the public meeting requiring amendment to the Proposed Plan, and no additional written comments, concerns, or questions were received from community members during the public comment period.



References

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
1	applicable or relevant and appropriate requirements (ARARs)	Section 1.4.2	CH2M HILL, Inc. (CH2M). 2016. <i>Feasibility Study, Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . October. Section 3.
2	training area	Section 2.1	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 2.
3	geological and hydrogeological characteristics	Section 2.2.2	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 2.
4	Ecological Risk Screening	Table 1	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 5.
5	Human Health Risk Screening	Table 1	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 5.
6	anomalies	Table 1	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 4.
7	explosive hazard assessment	Table 1	CH2M. 2016. <i>Feasibility Study, Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . October. Appendixes A and B.
8	remedial alternatives were evaluated	Table 1	CH2M. 2016. <i>Feasibility Study, Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . October. Section 4.
9	Screening Levels	Section 2.4	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 4.
10	risk ratio technique	Section 2.6.1	CH2M. 2015. <i>Remedial Investigation Report Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . March. Section 5.

Reference Number	Reference Phrase in ROD	Location in ROD	Identification of Referenced Document Available in the Administrative Record
11	Region 4 ESVs	Section 2.6.2	United States Environmental Protection Agency (USEPA). 2016. Regional Screening Levels for Chemicals at Superfund Sites. http://www.epa.gov/region09/waste/sfund/prg/index.html
12	Ecological Soil Screening Levels	Section 2.6.2	USEPA. 2015. Region 4 Ecological Risk Assessment Supplemental Guidance Interim Draft. http://www.epa.gov/ecotox/ecoss/ Accessed : June 2015
13	National Recommended Water Quality Criteria set	Section 2.6.2	USEPA. 2015. National Recommended Water Quality Criteria. Originally published May 2005. Website version updated in June 2015. http://epa.gov/waterscience/criteria/wqctable/
14	ORM and MEC HA methodologies	Section 2.6.3	CH2M. 2016. <i>Feasibility Study, Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . October. Appendixes A and B.
15	nine USEPA criteria	Section 2.9.2	CH2M. 2016. <i>Feasibility Study, Operable Unit 24/Site UXO-06, Former Fortified Beach Assault Area (ASR #2.65), Marine Corps Base Camp Lejeune, North Carolina</i> . October. Section 5.

Appendix A

ARARs

APPENDIX A

Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Location-Specific ARARs

Location	Requirement	Prerequisite	Citation
Presence of wetlands	Concentrations or combination of substances, which are toxic or harmful to human, animal, or plant life may not be present in amounts, which individually or cumulatively, can cause adverse impacts on existing wetland uses.	Activities within, wetlands as defined by G.S. 143-212(6) – Applicable	15A NCAC 02B.0231(b)(4)
	Standards provided in 15A NCAC 02B.0231(b)(1), (2), (3), (5), and (6) shall be used to ensure the maintenance or enhancement of the existing uses of wetlands identified in 15A NCAC 02B.0231(a)		
	Requires Federal agencies to evaluate action to minimize the destruction, loss or degradation of wetlands and to preserve and enhance beneficial values of wetlands.	Actions that involve potential impacts to, or take place within, wetlands – To Be Considered	Executive Order 11990 – <i>Protection of Wetlands</i> Section 1.(a)
Presence of Wetlands (as defined in 44 CFR § 9.4)	Minimize ¹ the destruction, loss or degradation of wetlands.	Federal <i>actions affecting or affected by Wetlands</i> as defined in 44 C.F.R. § 9.4 – Relevant and Appropriate	44 CFR § 9.11(b)(2) <i>Mitigation</i>
	The Agency shall preserve and enhance the natural and beneficial wetlands values.		44 CFR § 9.11(b)(4) <i>Mitigation</i>
	The Agency shall minimize: Potential adverse impact the action may have on wetland values.		44 CFR § 9.11(c)(3) <i>Minimization provisions</i>
Presence of floodplain designated as such on a map	Shall consider alternatives to avoid, to the extent possible, adverse effects on and incompatible development in the floodplain.	Federal actions that involve potential impacts on, or take place within, floodplains – To Be Considered	Executive Order 11988 – <i>Floodplain Management</i> Section 2(a)(2)
	Shall consider alternatives to avoid, to the extent possible, adverse effects and incompatible development in the floodplain. Design or modify its action in order to minimize potential harm to or within the floodplain		Executive Order 11988 Section 2(a)(2) <i>Floodplain Management</i>
Presence of floodplain designated as such on a map cont.	Where possible, an agency shall use natural systems, ecosystem processes, and nature-based approaches when developing alternatives for consideration.		Executive Order 13690 Section 2. (c)

¹ *Minimize* means to reduce to smallest amount or degree possible. 44 CFR § 9.4 Definitions.

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Location-Specific ARARS

Location	Requirement	Prerequisite	Citation
Presence of federally endangered or threatened species, as designated in 50 CFR 17.11 and 17.12 - or - critical habitat of such species listed in 50 CFR 17.95	Actions that jeopardize the existence of a listed species or results in the destruction or adverse modification of critical habitat must be avoided or reasonable and prudent mitigation measures taken.	Action that is likely to jeopardize fish, wildlife, or plant species or destroy or adversely modify critical habitat – Applicable	16 USC 1531 <i>et seq.</i> , Sect. 7(a)(2)
	Except as provided in the rule, no person may take the specified reptiles.	Action that is likely to jeopardize or adversely modify critical habitat for American alligator, green turtle, and/or loggerhead turtle – Applicable	50 CFR 17.42(a) and (b)
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony for Native Americans	Any person who knows or has reason to know that he or she has discovered inadvertently human remains, funerary objects, sacred objects, or objects of cultural patrimony on Federal or tribal lands after November 16, 1990, must provide immediate telephone notification of the inadvertent discovery, with written confirmation, to the responsible Federal agency official with respect to Federal lands, and, with respect to tribal lands, to the responsible Indian tribe official. The requirements of these regulations regarding inadvertent discoveries apply whether or not an inadvertent discovery is duly reported. If written confirmation is provided by certified mail, the return receipt constitutes evidence of the receipt of the written notification by the Federal agency official or Indian tribe official. NOTE: Although notification, certification, and consultation are generally viewed as 'administrative' requirements, these will be performed to ensure the substantive requirements are met.	Excavation activities that inadvertently discover such resources on federal lands or under federal control – Applicable	43 CFR 10.4(b) <i>Discovery</i>
	In addition to providing the notice described above, must stop the activity in the area of the inadvertent discovery and make a reasonable effort to protect the human remains, funerary objects, sacred objects, or objects of cultural patrimony discovered inadvertently.	Inadvertent discovery of such resources occurred in connection with an on-going activity on Federal or tribal lands – Applicable	43 CFR 10.4(c) <i>Ceasing activity</i>
	As soon as possible, but no later than three (3) working days after receipt of the written confirmation of notification with respect to Federal lands described in §10.4 (b), the responsible Federal agency official must: <ul style="list-style-type: none"> • Certify receipt of the notification; 	Excavation activities that inadvertently discover such resources on federal lands or under federal control – Applicable	43 CFR 10.4(d)(1) <i>Federal lands</i>

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Location-Specific ARARs

Location	Requirement	Prerequisite	Citation
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony for Native Americans cont.	<ul style="list-style-type: none"> Take immediate steps, if necessary, to further secure and protect inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony, including, as appropriate, stabilization or covering; Notify any known lineal descendants of a deceased Native American individual whose human remains and associated funerary objects were discovered of such discovery, and, with respect to a discovery of human remains, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony, notify the Indian tribes or Native Hawaiian organizations likely to be culturally affiliated with the cultural items, the Indian tribe or Native Hawaiian organization that aboriginally occupied the area, and any other Indian tribe or Native Hawaiian organization known to have a cultural relationship to the cultural items. This notification must be by telephone with written confirmation and must include information about the kinds of human remains, associated funerary objects, unassociated funerary objects, sacred objects, or objects of cultural patrimony, their condition, and the circumstances of their discovery; Initiate consultation on the inadvertent discovery pursuant to §10.5; If the human remains, funerary objects, sacred objects, or objects of cultural patrimony must be excavated or removed, follow the requirements and procedures in §10.3 (b) of these regulations; and Ensure that disposition of all inadvertently discovered human remains, funerary objects, sacred objects, or objects of cultural patrimony is carried out following §10.6. <p>NOTE: Although notification, certification and consultation are generally viewed as 'administrative' requirements, these will be performed to ensure the substantive requirements are met.</p>		
	The activity that resulted in the inadvertent discovery may resume thirty (30) days after certification by the notified Federal agency of receipt of the written confirmation of notification of inadvertent discovery if the resumption of the activity is otherwise lawful. The activity may also resume, if otherwise lawful, at any time that a written, binding agreement is executed	Excavation activities that inadvertently discover such resources on federal lands or under federal control – Applicable	43 CFR 10.4(d)(2) <i>Resumption of activity</i>

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Applicable and or Relevant and Appropriate Requirements**Federal and North Carolina Location-Specific ARARs**

Location	Requirement	Prerequisite	Citation
Presence of human remains, funerary objects, sacred objects, or objects of cultural patrimony for Native Americans cont.	<p>between the Federal agency and the affiliated Indian tribes or Native Hawaiian organizations that adopt a recovery plan for the excavation or removal of the human remains, funerary objects, sacred objects, or objects of cultural patrimony following §10.3 (b)(1) of these regulations. The disposition of all human remains, funerary objects, sacred objects, or objects of cultural patrimony must be carried out following §10.6.</p> <p>NOTE: Although notification, certification and consultation are generally viewed as 'administrative' requirements, these will be performed to ensure the substantive requirements are met.</p>		

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
<i>General construction standards – All land-disturbing activities (i.e., excavation, trenching, grading etc.)</i>			
Managing storm water runoff from land-disturbing activities	Shall install erosion and sedimentation control devices and practices sufficient to retain the sediment generated by the land-disturbing activity within the boundaries of the tract during construction.	Land-disturbing activity (as defined in NCGS Ch. 113A-53) of more than 1 acre of land – Applicable	NCGS Ch.113A-157(3) <i>Mandatory standards for land-disturbing activity</i>
	Shall plant or otherwise provide permanent ground cover sufficient to restrain erosion after completion of construction.		NCGS Ch.113A-157(3)
	The land-disturbing activity shall be conducted in accordance with the approved erosion and sedimentation control plan. <i>NOTE: Plan which meets the objectives of 15A NCAC 4B.0106 would be included in the CERCLA Remedial Design or Remedial Action Work Plan</i>		NCGS Ch.113A-157(5)
	Erosion and sedimentation control measures, structures, and devices within High Quality Water (HQW) zones shall be planned, designed and constructed to provide protection from the runoff of the 25 year storm.	Land-disturbing activity (as defined in NCGS Ch. 113A-52) of more than 1 acre of land in High Quality Water (HQW) zones – Applicable	15A NCAC 4B.0124(b)
	Provisions for ground cover sufficient to restrain erosion must be provided for any portion of the land-disturbing activity with 15 working days or 60 calendar days following completion of the construction or development, which period is shorter.		15A NCAC 4B.0124(e)
	Shall install and maintain all temporary and permanent erosion and sedimentation control measures.	Land-disturbing activity (as defined in NCGS Ch. 113A-52) of more than 1 acre of land – Applicable	15A NCAC 4B.0113

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Managing storm water runoff from land-disturbing activities cont.	Erosion and sedimentation control plan must address the following basic control objectives: <ul style="list-style-type: none"> Identify areas subject to severe erosion, and off-site areas especially vulnerable to damage from erosion and sedimentation. Limit the size of the area exposed at any one time. Limit exposure to the shortest feasible time. Control surface water run-off originating upgrade of exposed areas Plan and conduct land-disturbing activity so as to prevent off-site sedimentation damage Include measures to control velocity of storm water runoff to the point of discharge. 		15A NCAC 4B.0106
	Implement good construction management techniques, best management practices for sediment and erosion controls, and storm water management measures in accordance with 15A NCAC 02H.1008 to ensure storm water discharges are in compliance.	Development activity (otherwise requiring a stormwater permit) within one mile of and draining to waters classified as High Quality Waters (HQW) – Relevant and Appropriate	15A NCAC 02H.1006, NC General Permit CNGC 0100000
Control of fugitive dust emissions	The owner/operator of a facility shall not cause fugitive dust emissions to cause or contribute to the substantive complaints or visible emissions.	Activities potentially generating fugitive dust as defined in 15A NCAC 02D.0540 (a)(2) – Relevant and Appropriate	15A NCAC 02D.0540
<i>Waste characterization – primary wastes (contaminated media and munitions) and secondary wastes (contaminated personal protective equipment, etc.)</i>			
Characterization of <i>solid waste</i> (all primary and secondary wastes)	Must determine if solid waste is a hazardous waste using the following method: <ul style="list-style-type: none"> Should first determine if waste is excluded from regulation under 40 CFR 261.4; and Must then determine if waste is listed as a hazardous waste under subpart D 40 CFR part 261. 	Generation of solid waste as defined in 40 CFR 261.2 – Applicable	40 CFR § 262.11(a) and (b) 15A NCAC 13A.0106, .107

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Characterization of <i>solid waste</i> (all primary and secondary wastes) cont.	Must determine whether the waste is (characteristic waste) identified in subpart C of 40 CFR part 261 by either: <ul style="list-style-type: none"> • Testing the waste according to the methods set forth in subpart C of 40 CFR part 261, or according to an equivalent method approved by the Administrator under 40 CFR §260.21; or • Applying knowledge of the hazard characteristic of the waste in light of the materials or the processes used. 		40 CFR § 262.11(c) 15A NCAC 13A.0106
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste	Generation of solid waste which is determined to be hazardous – Applicable	40 CFR § 262.11(d); 15A NCAC 13A.0106
Characterization of <i>hazardous waste</i> (all primary and secondary wastes)	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 CFR 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal – Applicable	40 CFR § 264.13(a)(1) 15A NCAC 13A.0109
Determinations for management of hazardous waste	Must determine if the hazardous waste has to be treated before land disposed. This is done by determining if the waste meets the treatment standards in 40 CFR 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods <u>or</u> use of generator knowledge of waste. This determination can be made concurrently with the hazardous waste determination required in 40 CFR 262.11.	Generation of RCRA hazardous waste for storage, treatment or disposal – Applicable	40 CFR § 268.7(a)(1) 15A NCAC 13A.0106
	Must comply with the special requirements of 40 CFR § 268.9 in addition to any applicable requirements in 40 CFR § 268.7.	Generation of waste or soil that displays a hazardous characteristic of ignitability, corrosivity, reactivity, or toxicity for storage, treatment or disposal – Applicable	40 CFR § 268.7(a)(1) 15A NCAC 13A.0112

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Applicable and or Relevant and Appropriate Requirements**Federal and North Carolina Action-Specific ARARs**

Action	Requirements	Prerequisite	Citation(s)
Determinations for management of hazardous waste cont.	Must determine each EPA Hazardous Waste Number (waste code) applicable to the waste in order to determine the applicable treatment standards under 40 CFR 268 <i>et seq.</i> This determination may be made concurrently with the hazardous waste determination required in Sec. 262.11 of this chapter.	Generation of RCRA characteristic hazardous waste for storage, treatment or disposal – Applicable	40 CFR § 268.9(a) 15A NCAC 13A.0112
	Must determine the underlying hazardous constituents [as defined in 40 CFR 268.2(i)] in the characteristic waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal – Applicable	40 CFR § 268.9(a) 15A NCAC 13A.0112
Determinations for management of military munitions	A military munition is not a solid waste when: <ul style="list-style-type: none"> Used for its intended purpose, including: <ul style="list-style-type: none"> Use in training military personnel or explosives and munitions emergency response specialists (including training in proper destruction of unused propellant or other munitions); or Use in research, development, testing, and evaluation of military munitions, weapons, or weapon systems; or Recovery, collection, and on range destruction of unexploded ordnance and munitions fragments during range clearance activities at active or inactive ranges. However, “use for intended purpose” does not include the on-range disposal or burial of unexploded ordnance and contaminants when the burial is not a result of product use. 	Generation of military munitions [as defined in 40 CFR 260.10] during range clearance or recovery – Applicable	40 CFR § 266.202(a)

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Determinations for management of military munitions cont.	<p>An unused military munition is a solid waste when any of the following occurs:</p> <ul style="list-style-type: none"> • The munition is abandoned by being disposed of, burned, detonated (except during intended use as specified in paragraph (a) of this section), incinerated, or treated prior to disposal; or • The munition is removed from storage in a military magazine or other storage area for the purpose of being disposed of, burned, or incinerated, or treated prior to disposal, or • The munition is deteriorated or damaged (e.g., the integrity of the munition is compromised by cracks, leaks, or other damage) to the point that it cannot be put into serviceable condition, and cannot reasonably be recycled or used for other purposes; or • The munition has been declared a solid waste by an authorized military official. 	Generation of military munitions [as defined in 40 CFR 260.10] during range clearance or recovery – Applicable	40 CFR § 266.202(b)
	<p>A used or fired military munition is a solid waste:</p> <ul style="list-style-type: none"> • When transported off range or from the site of use, where the site of use is not a range, for the purposes of storage, reclamation, treatment, disposal, or treatment prior to disposal; or • If recovered, collected, and then disposed of by burial, or landfilling either on or off a range. 	Generation of military munitions [as defined in 40 CFR 260.10] during range clearance or recovery – Applicable	40 CFR § 266.202(c)
<i>Waste Storage – primary wastes (contaminated media and munitions) and secondary wastes (contaminated personal protective equipment, etc.)</i>			
Storage of solid waste	All solid waste shall be stored in such a manner as to prevent the creation of a nuisance, insanitary conditions, or a potential public health hazard.	Generation of solid waste which is determined <i>not</i> to be hazardous – Relevant and Appropriate	15A NCAC 13B.0104(f)

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Storage of solid waste cont.	Containers for the storage of solid waste shall be maintained in such a manner as to prevent the creation of a nuisance or insanitary conditions. Containers that are broken or that otherwise fail to meet this Rule shall be replaced with acceptable containers.		15A NCAC 13B.0104(e)
Temporary Storage of hazardous waste in Containers	A generator may accumulate hazardous waste at the facility provided that: <ul style="list-style-type: none"> waste is placed in containers that comply with 40 CFR 265.171–173; and the date upon which accumulation begins is clearly marked and visible for inspection on each container; container is marked with the words “hazardous waste”; or container may be marked with other words that identify the contents. 	Accumulation of RCRA hazardous waste on site as defined in 40 CFR §260.10 – Applicable Accumulation of 55 gal. or less of RCRA hazardous waste <u>or</u> one quart of acutely hazardous waste listed in §261.33(e) at or near any point of generation – Applicable	40 CFR § 262.34(a)(2) and (3); 15A NCAC 13A.0107 40 CFR §262.34(a)(1)(i); 15A NCAC 13A.0107 40 CFR § 262.34(c)(1) 15A NCAC 13A.0107
Use and management of hazardous waste in containers	If container is not in good condition (e.g. severe rusting, structural defects) or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers – Applicable	40 CFR § 265.171 15A NCAC 13A.0109
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 CFR § 265.172 15A NCAC 13A.0109
	Containers must be closed during storage, except when necessary to add/remove waste. Container must not be opened, handled and stored in a manner that may rupture the container or cause it to leak.		40 CFR § 265.173(a) and (b) 15A NCAC 13A.0109
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 CFR §264.175(b).	Storage of RCRA–hazardous waste in containers with <i>free liquids</i> – Applicable	40 CFR §264.175(a) 15A NCAC 13A.0109

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Storage of hazardous waste in container area cont.	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA–hazardous waste in containers that <i>do not contain free liquids</i> (other than F020, F021, F022, F023,F026 and F027) – Applicable	40 CFR § 264.175(c)(1) and (2) 15A NCAC 13A.0109
Closure performance standard for RCRA container storage unit	Must close the facility (e.g., container storage unit) in a manner that: <ul style="list-style-type: none"> Minimizes the need for further maintenance; Controls minimizes or eliminates to the extent necessary to protect human health and the environment, post–closure escape of hazardous waste, hazardous constituents, leachate, contaminated run –off, or hazardous waste decomposition products to the ground or surface waters or the atmosphere; and Complies with the closure requirements of subpart, but not limited to, the requirements of 40 CFR 264.178 for containers. 	Storage of RCRA hazardous waste in containers – Applicable	40 CFR § 264.111 15A NCAC 13A.0109
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed. [Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with 40 CFR 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262 through 266 of this chapter].	Storage of RCRA hazardous waste in containers in a unit with a containment system – Applicable	40 CFR § 264.178 15A NCAC 13A.0109

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Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Storage of solid waste military munitions	<p>Waste military munitions in storage that exhibit a hazardous waste characteristic or are listed as hazardous waste under 40 CFR Part 261, are listed or identified as a hazardous waste (and thus are subject to regulation under 40 CFR Parts 260 through 279).</p> <p>NOTE: Recovered military munitions waste that is considered RCRA hazardous waste must be stored in containers meeting the requirements identified above in this ARARs table.</p>	Storage of <i>waste non-chemical military munitions</i> that do not meet all of the conditions specified in 40 CFR 266.205(a)(1)(i) through (vii) – Applicable	40 CFR § 266.205(a)(1)
<i>Treatment/disposal of wastes – primary (contaminated media and munitions) and secondary wastes (contaminated personal protective equipment, etc.)</i>			
Disposal of solid waste	Shall ensure that waste is disposed of at a site or facility which is permitted to receive the waste.	Generation of solid waste intended for off-site disposal – Relevant and Appropriate	15A NCAC 13B.0106(b)
Disposal of RCRA hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table “Treatment Standards for Hazardous Waste” at 40 CFR 268.40 before land disposal.	Land disposal, as defined in 40 CFR 268.2, of restricted RCRA waste – Applicable	40 CFR § 268.40(a) 15A NCAC 13A.0112
	All underlying hazardous constituents [as defined in 40 CFR 268.2(i)] must meet the Universal Treatment Standards, found in 40 CFR 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001 –D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well – Applicable	40 CFR §268.40(e) 15A NCAC 13A.0112
	<p>To determine whether a hazardous waste identified in this section exceeds the applicable treatment standards of 40 CFR 268.40, the initial generator must test a sample of the waste extract or the entire waste, depending on whether the treatment standards are expressed as concentration in the waste extract or waste, or the generator may use knowledge of the waste.</p> <p>If the waste contains constituents (including UHCs in the characteristic wastes) in excess of the applicable UTS levels in 40 CFR 268.48, the waste is prohibited from land disposal, and all requirements of part 268 are applicable, except as otherwise specified.</p>	Land disposal of RCRA toxicity characteristic wastes (D004 –D011) that are newly identified (i.e., wastes, soil, or debris identified by the TCLP but not the Extraction Procedure) – Applicable	40 CFR § 268.34(f) 15A NCAC 13A.0112

APPENDIX A

Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Disposal of RCRA–hazardous waste soil in a land–based unit	Must be treated according to the alternative treatment standards of 40 CFR 268.49(c) or according to the UTs [specified in 40 CFR 268.48 Table UTS] applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 CFR § 268.2, of restricted hazardous <i>soils</i> – Applicable	40 CFR § 268.49(b) 15A NCAC 13A.0112
Treatment and disposal of waste military munitions	The treatment and disposal of hazardous waste military munitions are subject to the applicable RCRA treatment standards in 40 CFR 260 through 270. NOTE: Recovered military munitions waste that is considered RCRA hazardous waste must be treated or disposed in accordance with the requirements identified above in this ARARs table.	Generation of military munitions [as defined in 40 CFR 260.10] during range clearance or recovery – Applicable	40 CFR § 266.206
Treatment of hazardous waste in Misc. Treatment Unit with air emissions	Unit must be located, designed, constructed, operated and maintained, and closed in a manner that will ensure protection of human health and the environment.	Treatment of RCRA hazardous waste (including military munitions waste) in miscellaneous units, except as provided in 40 CFR 264.1– Relevant and Appropriate	40 CFR 264.601
	Protection of human health and the environment includes, but is not limited to: prevention of any release that may have adverse effects on human health or the environment due to migration of waste constituents in the air, considering the factors listed in 40 CFR 264.601(c)(1) thru (7).		40 CFR 264.601(c)
Transportation of Wastes – Primary and Secondary Wastes			
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMTA and HMR at 49 CFR 171–180.	Any person who, under contract with a department or agency of the federal government, transports “in commerce,” or causes to be transported or shipped, a hazardous material – Applicable	49 CFR § 171.1(c)

APPENDIX A

Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Transportation of hazardous waste <i>off site</i>	Must comply with the generator requirements of 40 CFR Sect. 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding and Sect. 262.40, 262.41(a) for record keeping requirements and Sect. 262.12 to obtain EPA ID number.	Preparation and initiation of shipment of RCRA hazardous waste off-site – Applicable	40 CFR § 262.10(h) 15A NCAC 13A.0108
Transportation of hazardous waste <i>on-site</i>	The generator manifesting requirements of 40 CFR Sect. 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 CFR § 263.30 and § 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way – Applicable	40 CFR § 262.20(f) 15A NCAC 13A.0108
Management of samples (i.e. contaminated soils and wastewaters)	Are not subject to any requirements of 40 CFR Parts 261 through 268 or 270 when: <ul style="list-style-type: none"> • The sample is being transported to a laboratory for the purpose of testing; • The sample is being transported back to the sample collector after testing; and • The sample collector ships samples to a laboratory in compliance with U.S.DOT, U.S. Postal Service, or any other applicable shipping requirements, including packing the sample so that it does not leak, spill or vaporize from its packaging. 	Generation of samples of hazardous waste for purpose of conducting testing to determine its characteristics or composition – Applicable	40 CFR § 261.4(d)(1)(i) and (ii) 15A NCAC 13A.0108 40 CFR § 261.4(d)(2) 15A NCAC 13A.0108
Institutional Controls for Contamination Left in Place			
Notice of Contaminated Site	Prepare and certify by professional land surveyor a survey plat which identifies contaminated areas which shall be entitled “NOTICE OF CONTAMINATED SITE”. Notice shall include a legal description of the site that would be sufficient as a description in an instrument of conveyance and meet the requirements of NCGS 47-30 for maps and plans.	Contaminated site subject to current or future use restrictions included in a remedial action plan as provided in NCGS 143B-279.9(a) – TBC	NCGS 143B-279.10(a)

APPENDIX A

Applicable and or Relevant and Appropriate Requirements

Federal and North Carolina Action-Specific ARARs			
Action	Requirements	Prerequisite	Citation(s)
Notice of Contaminated Site cont.	The Survey plat shall identify: <ul style="list-style-type: none"> the location and dimensions of any disposal areas and areas of potential environmental concern with respect to permanently surveyed benchmarks; the type location, and quantity of contamination known to exist on the site; and any use restriction on the current or future use of the site. 		NCGS 143B-279.10(a)(1)-(3)
	Notice (survey plat) shall be filed in the register of deeds office in the county which the site is located in the grantor index under the name of the owner.		NCGS 143B-279.10(b) and (c)
	The deed or other instrument of transfer shall contain in the description section, in no smaller type than used in the body of the deed or instrument, a statement that the property is a contaminated site and reference by book and page to the recordation of the Notice.	Contaminated site subject to current or future use restrictions as provided in NCGS 143B-279.9(a) that is to sold, leased, conveyed or transferred — TBC	NCGS 143B-279.10(e)

Notes:

ARAR = applicable or relevant and appropriate requirement

CFR = *Code of Federal Regulations*

CWA = Clean Water Act of 1972

DOT = U.S. Department of Transportation

EPA = U.S. Environmental Protection Agency

NCAC = *North Carolina Administrative Code*

N.C.G.S = North Carolina General Statutes

NPDES = National Pollutant Discharge Elimination System

HMR = Hazardous Materials Regulations

HMTA = Hazardous Materials Transportation Act

RCRA = Resource Conservation and Recovery Act of 1976

TBC = to be considered

UTS = Universal Treatment Standard

Appendix B

Acronyms and Abbreviations

Acronyms and Abbreviations

3Rs	Recognize, Retreat, Report
AR	administrative record
ARAR	applicable or relevant and appropriate requirement
ASR	Archive Search Report
bgs	below ground surface
BPEA	Borrow Pit Expansion Area
BTV	background threshold value
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COPC	constituent of potential concern
CR	cancer risk
DDT	dichlorodiphenyltrichloroethane
DGM	digital geophysical mapping
EOD	explosive ordnance disposal
ERS	Ecological Risk Screening
ESS	Explosives Safety Submission
ESV	ecological screening value
FFA	Federal Facilities Agreement
FS	Feasibility Study
HA	Hazard Analysis
HHRA	Human Health Risk Assessment
HHRS	Human Health Risk Screening
HI	hazard index
HQ	hazard quotient
HQW	High Quality Water
IMAC	Interim Maximum Allowable Concentration
IRP	Installation Restoration Program
LUC	land use control
LUCIP	Land Use Control Implementation Plan
MC	munitions constituents
MCB	Marine Corps Base
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MILCON	Military Construction
MEC	munitions and explosives of concern
MEC HA	MEC Hazard Assessment
mm	millimeter
MMRP	Military Munitions Response Program
MPPEH	material potentially presenting an explosive hazard
MRS	Munitions Response Site
Navy	Department of the Navy
NC SSL	North Carolina Soil Screening Levels for the protection of groundwater
NCAC	North Carolina Administrative Code

ACRONYMS AND ABBREVIATIONS

NCDEQ	North Carolina Department of Environmental Quality
NCGS	North Carolina General Statute
NCGWQS	North Carolina Groundwater Quality Standards
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
ORM	Operational Risk Management
OSHA	Occupational Safety and Health Administration
OU	operable unit
PA	Preliminary Assessment
PTW	principal threat waste
RAC	Risk Assessment Code
RAO	remedial action objective
RD	remedial design
RI	Remedial Investigation
ROD	Record of Decision
RSL	regional screening level
SAA	small arms ammunition
SI	Site Inspection
SVOC	semivolatile organic compound
TBC	to-be-considered
TPH	total petroleum hydrocarbons
USEPA	United States Environmental Protection Agency
USMC	United States Marine Corps
UXO	unexploded ordnance
VOC	volatile organic compound

Appendix C
NCDEQ Concurrence Letter
